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## WIDDINGTONIA JUNIPEROIDES ENDL.

ERNEST H. WILSON

*Plate 15*

Widdringtonia is the African analogue of the northern genus Cupressus and the two genera closely resemble one another in their vegetative parts and in the character and odor of their timber. Some six species of Widdringtonia have been recognized and with one exception all have a very limited geographical distribution.

The subject of this note is confined to the Cedarberg Mountains near Clanwilliam and about 180 miles north of Cape Town. It is commonly known as the Clanwilliam Cedar and gives its name to the mountain range, the Cedarbergen, on which it grows. These mountains are from 4,800 to 6,336 feet high, composed mainly of Table Mountain sandstone and shale band, and are worn into bold cliffs, either bare or clothed with a scrub growth of shrubs and herbs in which coarse grasses are prominent. Between elevations of from 3,000 to 5,000 feet above sea-level, this Widdringtonia is strewn over an area of about 30 miles either singly or in thin groves. It grows in the rocky crevices and among the boulders, and often stands out in the face of the sheer cliffs. It is doubtful if this tree ever formed real forests and in all probability always grew either scattered or in small groves just as it does today.

Accompanied by the Conservator of Forests, Mr. C. R. Ross, I made a special journey in March 1922 from Cape Town to the Cedarbergen for the purpose of studying and photographing this tree, and the one thing that astonished me, over and above everything else, was that the tree could flourish under such stark conditions. At one time it was quite common on this mountain range but axe and fire, especially fire, have reduced its number to a comparative few hundreds. Young plants are springing up everywhere among the rocks and if fires be kept out the species is safe.

When exploring this part of South Africa, Sir James Alexander remarks that a Cedar tree which was cut down in 1836 was 36 ft. in girth of trunk and out of its giant arms a thousand feet of plank was sawn. No such enormous trees exist today. The largest tree I saw, measured and noted down, was 40 ft. tall with a trunk 13 ft. in girth at breast height.

The crown of the Clanwilliam Cedar is more or less flattened and irregular in outline and made up of many massive horizontally spreading

or slightly ascending branches. The branchlets are terete and on very old trees numerous toward the extremity of the branches which gives a tufted appearance to the crown from a short distance. On the young shoots the bark is brownish purple; later it becomes fissured and broken into small blackish gray, rectangular flakes which show a vinous purple color beneath. As a rule the trees branch from near the ground and the trunks and main branches clothed with tessellated bark are beautiful. On young saplings the branches are erect or erect-spreading and in its early years this tree is columnar in outline. As it grows older, stout lateral branches are thrust out more or less horizontally and develop into a flattened crown. The leaves are opposite, decussate, and dimorphic. On young plants they are lance-shaped but on adults scale-like. The resemblance of this particular species in its youth to *Juniperus chinensis* L. is remarkable.

The fruits are crowded around the shoots, mark the base of a season's growth and take two years to ripen. The woody capsule at maturity is blackish purple, almost an inch square, warted without and more or less coated with resin.

The timber of the Clanwilliam Cedar is perhaps the most valuable of any African softwood tree but is now so rare that it is of little or no commercial importance. The wood is oily and inflammable, white or slightly yellowish, well figured, fragrant and saws and planes well. It is easily carved and eminently suitable for furniture and cabinet-making. It has a strong Cedar-like odor agreeable to the nostrils. A church in Clanwilliam has pews, doors and the altar front made out of this wood. In the ground it is almost everlasting, a quality which it shares with the wood of most *Cupressus* and *Juniperus*.

From the branches and cones of the tree a yellowish transparent resin is exuded which is used locally in the form of fumigations as a cure for gout and rheumatism and also in the compounding of plasters and the preparation of varnish.

The Cedarbergen, where this *Widdringtonia* finds its home, enjoys a light winter rainfall, the annual precipitation never exceeding 15 inches. Frost and snow occur during the winter and the small ponds and ditches of still water are often frozen over. The climate is indeed extreme, the summers being very hot and dry and the winters wet and miserably cold. This *Widdringtonia* is found between 3,000 and 5,000 ft. and reaches its optimum round about 4000 ft. It keeps to the upper-middle parts of the range and does not live long under cultivation in the lower valleys. It is indeed a very isolated species, demanding peculiar ecological conditions not easily found elsewhere.

The Clanwilliam Cedar was one of the first of the Cape trees to be grown in England. Philip Miller in his "Dictionary" records raising plants from seed he had received, some of which were killed in open ground in the winter of 1756. Being tender in north temperate regions, it is doubtful if this tree is now in cultivation.

## A FUNGUS DISEASE OF CONIFERS RELATED TO THE SNOW COVER

J. H. FAULL

UNTIL towards the close of the last century the vast forests of America seemed to be sufficient for all demands that might be made on them for all time. Fear that such might not be the case was first aroused by obtruding evidence of rapid depletion of the White Pine. This found expression in active propaganda for replacement by planting. But a resultant planting campaign scarcely began when it received an unforeseen check through the announcement about 1910 that a potentially dangerous blister rust had been imported in nursery stock and had been widely distributed. In consequence of the thorough establishment of that unwelcome pest even the most optimistic nowadays agree that the restoration of some of our White Pine forests at least will involve arduous, vigilant and expensive effort.

When the supply of White Pine waned we turned to less valuable woods such as Spruce and Fir. As the years have gone by the demand for them has steadily mounted because continually additional uses have been found for them—as for the manufacture of paper and viscose. Consumption has proceeded at an accelerated pace, so that in turn their early exhaustion is no idle threat. To forestall an eventuality that would be so disastrous to the welfare of great industries, to communities directly dependent on them, and to the public in general, it has been for some time apparent that measures of economy and replenishment must be devised and practised. Planting, better management, and closer utilization have been proposed as means affording a solution, and beginnings have been made along these lines. But once again, in certain regions there has loomed up an imminent frustration of planting policies because of the appearance of an unexpected disease.

This disease has been one of the subjects of my researches during the last two years, and the purpose of this paper is to present an account of its nature, cause, origin and control. It may properly be named "Phacidium blight of conifers."

My attention was first called to Phacidium blight during the summer of 1923 in a large spruce nursery whose output runs into the millions of trees each year, though I afterwards knew that that was not my first contact with it. I had long known it on Fir, though not its cause, and have since found it in various parts of the northeastern United States and eastern Canada on Fir, the Spruces, and occasionally on Pines and Arbor-vitae. Its attack is *en masse* on leaves of all ages, but only on those needles that lie below the snow cover. Its virulence is so severe that few Fir or Spruce trees once involved escape destruction unless their leaders are well above the surface of the snow.

The affected parts are a soft and more or less glaucous brown color. In closely planted nursery beds it occurs in subcircular patches up to two feet

or more in diameter, or in strips where the plants are in fully separated lines. As for older trees, masses of branches on one side or all within certain horizontal planes are browned; and if they have suffered in previous years the newly browned foliage is contiguous to old more or less completely defoliated branches, or to those that are covered with withered and whitened needles. Leaves of all ages are equally liable to attack. Diseased needles of White Pine drop during the first summer, those of Fir and Arborvitae carry through the following winter, while those of the Spruces likewise commonly adhere throughout the winter unless too much subjected to drought or wind or other disturbing agencies.

The disease as first seen by me in the nursery was on two and three-year old beds of White Spruce. The latter had suffered the year before and were mostly a complete loss. But they, like the former, were said to have entered their first winter perfectly green. The brown needles showed submerged black dots, evidently incipient fungus fruits, but there was no evidence at that time to show that the fungus might not be purely secondary. The blight, whatever its cause might be, had not spread subsequently to the uncovering of the beds through the melting of the snow a few months previously.

The losses and expansions of invasion in the springs of 1924, 1925 and 1926 were reported to be continually mounting at a rapid rate, and those of 1926 were so enormous that the future of the nursery was jeopardized. The problem was then actively taken up, and during 1927 visits were made in the spring just as the snow was leaving, again in midsummer, and finally towards the end of the fall. At my suggestion, Mr. G. G. Cossens, a resident forester, marked the limits of a number of spots in the beds and staked individual diseased trees here and there in the transplant lines in the fall of 1926, so that in the following spring we might have definite information as to whether or not there was a spread from these foci.

To the symptoms just recorded, may be added the appearance of sub-epidermal disk-like apothecia in the fall on needles browned the preceding spring. These are exposed by the irregular dehiscence of the overlying epidermis, and from them there is spore-discharge in mild, damp weather until winter sets in. There has also been noted an almost constant occurrence of black microsclerotia on the affected needles in the spring. Likewise, observation at the right moment in the spring reveals a more or less evident covering of white mycelia on the browned foliage just as the snow melts away.

#### CAUSE

After becoming familiar with the symptoms, the next step was to determine the cause. In view of the time at which the disease manifested itself it was natural to suspect winter injury. But with knowledge of the continuous aggravation of the malady throughout a period of years, such an explanation was not convincing. Since the grass and the low-lying vegetation everywhere in that region, as well as the brown spots, are cover-

ed with a white cobwebby gauze as the snow disappears, it was suggested that this might furnish a clue. But the molds on the grass were found to consist of the mycelia of a few species of fungi that apparently were purely saprophytic. Several experiments and observations, however, have demonstrated beyond question that the disease is infectious and contagious and that it is due to a fungus. These are as follows:

1. The mesophyll of the browned needles from the first is occupied by intercellular hyaline hyphae and cultures show that it is always the same fungus.

2. The spread of the disease from spring to spring is to contiguous foliage.

3. Wherever the needles of adjacent susceptible conifers come into contact with diseased foliage they, too, are likely to be browned.

4. From the preliminary markings made in the fall of 1926 in nursery beds and transplant lines there was an extensive spread showing in the spring of 1927.

5. From the reported history of the disease in two nurseries, one in Quebec and the other in New England, we know with reasonable certainty that it began in both at recognized limited points, and its spread from them has been disturbingly noted.

6. Experimental plots were staked out in nursery beds, transplant lines and plantations—about 30 acres in all—during the season of 1927, and the diseased spots and trees were marked. In all cases a spread was revealed in the spring of 1928. The lateral spread in the nursery plots affords a striking illustration. The areas diseased in ten 2-year old beds of White Spruce in 1927 ranged from 3% to 40% in extent, with an average of 18.4%; in the spring of 1928 the range was from 12% to 85%, with an average of 47.2%.

7. Net bags of diseased Spruce needles were hung in the crowns of healthy Spruces in a disease-free plantation in November, 1927, just at the onset of winter, all below the snow line (12 experiments). In the spring of 1928, as the snow fell away, these bags were seen to be the centres of subspherical masses of brown foliage a foot to two feet in diameter, and nowhere else in the plantation did the disease develop.

8. Mr. G. D. Darker similarly suspended bags of diseased Balsam Fir in Balsam Fir, Hemlock, and White Pine trees in the fall of 1927. Browning showed in the adjacent foliage and not elsewhere in the spring of 1928.

A study of the fungus proves that it a species of *Phacidium*. Morphologically the ascospores are in general like those of *Phacidium infestans* but there are certain features in connection with the fructifications, the mycelial cultures, and the pathogenicity that deter me from deciding finally whether or not the form on Spruce may be varietally different, and whether or not the forms on Spruce and Fir may always be varietally the same. So far as can be learned from the literature and through correspondence,

*P. infestans* is known only on *Pinus sylvestris* in Europe. The only record in America is by Weir, who found a parasitic *Phacidium* on certain western species of *Abies* and on Douglas Fir which he called *P. infestans* var. *Abietis*.

All of the means of dissemination have likewise not yet been cleared up. It seems obvious that primary infection is by means of discharged ascospores in the fall. These germinate readily without a resting period. It is of course possible that some of them may carry through the winter and cause infection in early spring. It also seems likely that the microsclerotia referred to above are a phase of the fungus and that they may cause infection. It is certain that a very important cause of infection is the mycelium in the browned needles. During the latter part of the following winter, for a few weeks before the snow departs, this mycelium grows out under the snow over to adjacent foliage and enters dormant healthy needles. Foliage in contact with browned branches has been dug up in late winter and at that time these phenomena were beginning to show. The temperature in the crust-covered air pockets around branches or small trees varied from 36 to 43° F. on bright sunny days during the period of thaws. Mycelial spread was also seen to advantage in the thawing season in beds covered over by a low platform of boards.

#### CONTROL

The question of control was naturally uppermost in mind from the first, and every new acquisition of knowledge regarding the cause of the disease and the behavior of the pathogen was treasured for its possible bearing on an efficient method of control. The European literature had nothing to offer on this matter for it was acknowledged by European pathologists that no effective means had been devised for combating *P. infestans*.

Acting on general principles it seemed advisable to practice thorough sanitation in the nursery so far as possible. Hence as a first measure badly diseased beds were treated with a strong lime-sulphur spray and turned under with the plow. Then an extensive program of spraying experimentation was projected. For this purpose thirty-seven beds of White Spruce and nine plots of 2-1 (2 years in nursery beds, 1 year in transplant lines) transplants were reserved. The latter measured 10,000 square feet each, with about 40,000 young trees in each plot. These experiments consisted of sprayings with lime-sulphur (dormant) of various strengths, part in late spring and part in the fall up until the first snows fell; in some the browned plants were first eradicated, in others they were not disturbed. A few plots were not treated, but left as controls. The results have been highly gratifying. Removal of the diseased stock before spraying proved to be of no value. Spraying in the spring was likewise of no effect. On the other hand spraying in the late fall with lime-sulphur gave perfect control. One very interesting result noted was that browned, unpulled spots, not only showed no spread after fall spraying, but some of the appar-

ently dead plants revived to the extent of unfolding meagre new foliage in the following spring.

Having discovered the ascosporic fructifications in the fall of 1927, and knowing of the mycelial habit of spread, it was surmised that if spraying were of any avail the fall would be the proper time to make the application. So the beds throughout the nursery not reserved for experiment were treated to a dormant lime-sulphur spray. The nursery uncovered in the spring of 1928 without a blemish and continued so for the rest of the season. For the first time in years the nursery was free from the *Phacidium* blight.

In attempting to control the blight on the plantations several procedures are being followed. For planting, only positively healthy stocks are used, and such plants are first sprayed or dipped in lime-sulphur. In some of the established plantations the diseased stock was pulled by hand and carried in sacks to canvas-lined wagons, removed and burned. The full value of this latter measure cannot be fully appraised for another year or two, but success is anticipated. It is possible that thorough fall spraying of diseased trees in the plantations might be successful and practicable; if so a large proportion of affected trees would be conserved; an experiment of this type has been projected.

At the suggestion of Mr. Ellwood Wilson, diseased branches were removed from a number of six or eight-year-old trees in the fall of 1927 and burned. Some of these trees showed a little browning in the spring of 1928, but several came through clean.

The cost of fall spraying in the nursery and of removal of diseased plants from the plantations is trifling.

#### DISTRIBUTION AND ORIGIN OF PHACIDIUM BLIGHT

It is obvious that a knowledge of the origin of such a disease is of great importance in relation to many questions, such as the possibility of attack in any nursery, the effect on natural regeneration if it be native, and on the advisability of quarantine and embargo.

I have long been familiar with this disease on Balsam Fir, and have found it everywhere in the snow laden parts of Ontario and Quebec and in several of the northeastern States. But I was not so certain of its occurrence on native Spruce. In order to determine this matter I made journeys into the Spruce forests of Gaspé, Quebec, and Maine in September and November of 1928, and was rewarded by finding it in both places on White, Red, and to a lesser extent on Black Spruce, in regions where it was plainly native. A review of collections made previously and subsequently at various locations in the east, adds to the evidence that it is widely distributed on Spruce in eastern Canada and in the northeastern States. It is a safe conclusion that *Phacidium* blight of conifers is native to America. Under such circumstances the sane procedure is not to employ embargo or quarantine except in the case of wilfully neglected nurseries, but to be ever on the alert and to adopt control measures wherever it shows itself.

## SUMMARY AND CONCLUSIONS

1. Phacidium blight of conifers is a disease favored by a covering of snow that persists throughout the winter. In Europe it (Schneeschütte) attacks *Pinus sylvestris* and is said to be caused by *Phacidium infestans*. In America various conifers are attacked; the Firs and various Spruces are especially susceptible; it is caused by a form or forms very similar to if not identical with *P. infestans*.

2. An extensive contagious spread takes place under the snow in late winter and early spring and there is none throughout the summer.

3. Any nursery or plantation in a snow laden area is liable to attack, and especially so if it be located in a forested district.

4. It is a disease that is potentially capable of rapid spread and great losses.

5. Being native there is more or less of a balance as between host and parasite under natural conditions. It is conceivable, however, that in many areas the natural regeneration of such a susceptible host as White Spruce may be seriously affected by it. So far no studies have been made on this point.

6. It has been found that it can be easily and cheaply controlled.

7. A reforestation planting policy in snow laden areas is liable to failure unless Phacidium blight be controlled.

Throughout the course of this investigation I have received generous support and invaluable co-operation from many quarters; due acknowledgments will be made in a detailed paper to be published in the near future.

## THE LIGNEOUS FLORA OF THE DAVIS MOUNTAINS, TEXAS

ERNEST J. PALMER

Far out towards the southwestern corner of the great state of Texas, but still some two hundred miles east of El Paso, the rugged peaks and ridges of the Davis Mountains rise rather abruptly from the surrounding high plains. Owing to the isolation of those outlying groups of the Rocky Mountains which occupy the generally arid region of western Texas they offer an extremely interesting field for the study of peculiar phases of the flora and fauna. And the Davis group, because of the higher altitude and the precipitous character of some of the mountains and other ecological factors to be mentioned later, seems to constitute one of the most distinct sub-regions biologically to be found in the state.

The Davis Mountains lie entirely within the limits of Jeff Davis County, a large area separated politically several years ago from Presidio County. The area of the county is 2263 square miles and the population according to the last census was only 1445. The number of inhabitants is somewhat, though not materially larger at present. Nearly half of the people live in the two principal towns of Ft. Davis and Valentine, the remainder be-

ing widely scattered over the great ranches that occupy nearly all of the county.

The elevation of Ft. Davis, which lies at the foot of the mountains and in the valley of Limpia Creek, is about 1600 meters (5200 ft.) above sea level.

Just west of the town lies the old military fort, established in 1854 by Jefferson Davis while Secretary of War in the cabinet of President Pierce. This was built as one of the line of frontier forts to afford protection to the traders and early settlers against the hostile Indians. The Apaches who roamed over this part of the Southwest were one of the most war-like and troublesome of all of the tribes, and they continued to be a menace and source of trouble until comparatively recent times. A regiment of cavalry was stationed here for many years and the fort was finally abandoned as a military post in 1891. The buildings, which were nearly all constructed of adobe blocks, are now only a picturesque group of ruins in various stages of dilapidation. Some of the officer's houses and the cottages of the non-commissioned officers are still practically intact, while the old hospital and barracks are rapidly disintegrating and only the outlines of some of the other buildings can now be traced.

Most of the buildings of the modern town are also of adobe, but some of them have been covered with stucco, and the court-house and a few of the more pretentious business buildings are constructed of native stone. Alpine, Marfa, and Valentine, each more than 20 miles distant, are the nearest railroad points, and until recently the town had remained quite isolated and primitive, serving only as a supply point for the ranchers in addition to being the seat of the county government. But since the construction of automobile roads in the last few years the place has begun to attract many summer tourists. The distinctive character of the village, with its flavor of the old Southwest, its cool nights, clear skies and dry crisp air and the opportunities it affords for excursions into the mountain fastnesses and for seeing something of the rapidly disappearing ranch life, which has persisted here more typically than in most parts of the West, serve well to repay those who have the enterprise to turn aside from the beaten tracks of travel to enjoy the hospitality of this little mountain town.

Limpia Creek, which has its rise in the higher mountains, flows by the town and furnishes the water supply. Several strong perennial springs emerge in the canyon a little distance above the old fort, and the water from these is also used for irrigating small tracts in the valley, most of which are devoted to apple orchards. Some fine apples are raised here, and since the area is far removed from any other where they are grown at present, the industry is generally a profitable one.

The low hills and plains in the vicinity of the town are mostly devoid of woody growth, with the exception of a few Mesquite bushes, Cacti, Yuccas and other semi-desert shrubs. Along rocky ravines and in the protection of cliffs and canyons in the foot-hills many other plants appear

and the flora is more varied and richer especially in woody species. This diversity increases more rapidly and the different plant zones become more distinctly marked as the higher altitudes in the mountains are reached. Many of the species are quite local, their ability to survive depending upon peculiar conditions of protection, moisture and shade. Near the town and the old fort some very large Cottonwood trees (*Populus Wislizeni* and *P. McDougalii*) are growing, which are said to have been planted shortly after the establishment of the military post. Small groves of the same species are found at intervals for some miles down the valley of the Limpia, giving a pleasing touch of shade and vendure to the otherwise bare landscape.

The Davis Mountains consist of numerous peaks and ridges, some of them isolated and separated from each other by broad canyons and valleys or stretches of open plain, and others closely aggregated into irregular groups rather than into definite ranges, and divided only by deep narrow canyons or gorges with high cliffs and bold naked promontories, often difficult to reach and impossible to scale.

The rocks forming these mountains are all igneous and owe their origin to a great upthrust of intrusive material during one of the mountain-forming periods subsequent to the Lower Cretaceous. The formations consist of rhyolites, syenites, trachytes and similar crystalline rocks, with beds of lava indicating later volcanic activity in many places. Lava flows are conspicuous in the immediate vicinity of old Ft. Davis, and where also noted on the west slope of Mt. Livermore and on the Fowlkes ranch, near the head of the Big Aguja Canyon, and at several places in the lower part of Limpia Canyon. In some places false bedding planes and systems of horizontal fissures give to the porphyritic rocks the appearance of stratification. Near the head of Madera Canyon, at an altitude of approximately 2100 meters, the trail crosses a low ridge on which a deposit of thinly-bedded sandstone with dendrite markings is exposed. I was unable to determine what the geological position of this formation is or its relation to the igneous rocks.

On the extreme northern flank of the mountains some beds of limestone of the Comanchean series are found, which are the only extensive deposits of sedimentary rocks in the region, and these seem to have had some influence upon the flora. The appearance of the Chinquapin Oak (*Quercus Muhlenbergii*) in the Little Aguja and the lower part of the Madera Canyons and elsewhere in that part of the mountains is doubtless due to the influence of the limestones, although some of the trees are growing some distance beyond the limits of these deposits at present.

The soils resulting from the decomposition of the igneous rocks are generally acid in varying degrees, and this is one of the factors determining the character of the flora over most of the region. It is rather curious, however, that only one Ericaceous plant (*Arbutus texana*) is found, members of this family not having generally adapted themselves to xerophytic conditions.

In some of the protected canyons, and especially under the high cliffs about Mt. Livermore, the soil has been considerably enriched by humus. This appears to be one of the factors that account for the survival in such places of a number of mesophitic plants of distinctly northern origin, that will be described later.

The soil in the open valleys and on the slopes and hillsides is usually very porous and intermingled with rock fragments and gravel. And on the steeper slopes the naked igneous rocks that cover most of the surface, being poorly adapted for absorbing or retaining moisture, cause a rapid run-off after rains, thus soon rendering the surface dry and sterile and capable of supporting only the more xerophytic forms of plant life. Only at a few places where springs issue following systems of fissures or faults, or where water flowing over impermeable rocks in some of the stream beds emerges from the gravel to form pools, is the water supply sufficiently abundant or permanent to enable many moisture-loving species to maintain themselves.

Rainfall over the whole region is light, the average annual amount being about 20 inches. Most of the precipitation occurs in the form of local showers and torrents, covering very limited areas. These occur most frequently during the summer and autumn months. Due to the local character of the rainfall the amount received by any given area is quite uncertain, and there is much variation in different years. Temperatures several degrees below freezing point and sometimes as low as zero Fahrenheit, or even below, occur in the winter months. Light snows sometimes fall during the winter and early spring months, and sleet and hail are common forms of precipitation during the latter season.

The following tables of weather data are taken from the figures of the United States Weather Bureau for Ft. Davis, where records of precipitation by months have been kept from 1855 to 1920, several years being omitted and the data for some years being incomplete. In the first column the average for the 45 years reported is shown by months, with the total annual average, and in the second column the figures are for the nine years from 1912 to 1920, for which the record was complete. The figures are in inches and fractions of inches.

Average precipitation by months  
for 45 years, between  
1855 and 1920

For 9 years, 1912 to 1920

Jan.	.0 53	0.54
Feb.	.0 44	0.23
March	.0 37	0.34
April	.0 55	0.64
May	.1 13	1.65
June	.1 95	2.19
July	.3 24	2.78
Aug.	.3 60	4.10
Sept.	.2 90	3.04
Oct.	.1 28	1.19
Nov.	.0 64	0.92
Dec.	.0 54	0.47
Mean annual for period	17.17	22.6

The variation from year to year as shown by the figures is very great. In 1871 the annual total was only 6.78, while in 1881 it was 27.54. Correspondingly great variations occurred during some months. Thus in July, 1875, the total precipitation shown is 15.36, while for the same month in 1903 it is only 0.15, and in February, one of the driest months, the variation is from 0 in a number of years to 3.54 in 1877. In the winter and early spring frequently no precipitation occurs for several consecutive months, and in the dry year of 1871 there was only a trace from January to June inclusive.

Temperature figures show equally great variations. Records are in degrees Fahrenheit, those for the highest and lowest thermometer readings covering a period of 16 years, those for the mean minima and maxima 5 years, and for the averages 13 years.

	Highest records	Lowest records	Mean maximums	Mean minimums	Averages
Jan.	77	-3	58.6	28.9	43.8
Feb.	85	3	60.7	31.3	48.6
March	87	15	68.3	38.7	55.0
April	95	24	76.2	46.6	62.5
May	101	38	83.5	53.3	70.3
June	111	42	87.6	60.8	74.9
July	110	47	86.0	61.3	75.1
Aug.	100	47	86.4	60.8	73.9
Sept.	94	37	80.7	55.5	68.6
Oct.	90	22	73.6	46.6	61.0
Nov.	82	6	65.1	36.6	51.3
Dec.	80	1	56.1	29.0	45.2

Frost data over a period of 29 years shows the earliest date for a killing frost in autumn as Oct. 1st, and the latest date in spring as May 2nd, while the average for the period was Oct. 15th and April 2nd, respectively.

No definite weather data is available for the higher mountains, but it is certain that lower temperatures occur and that considerably more precipitation is received at the higher altitudes than in the plains. The interception of moisture-laden clouds floating at low elevations by the lofty mountains probably results in several inches of additional rainfall, and the evaporation of this is considerably retarded in the deep shaded canyons.

The factors, therefore, that appear to limit the distribution of species and to have determined the character of the flora as it has developed in different parts of the region are moisture, as received in the form of rainfall or as it is present in springs and perennial streams; protection afforded by bluffs and canyons against the hot dry winds of the plains; altitude, as it effects rainfall and temperature; and the physiographic and geologic history of the region. The last factor, while necessarily an uncertain one and one that can be approached only hypothetically, is nevertheless probably one of the most important, and it is certainly one of the most interesting; since under changing conditions of geography and climate successive waves of flora have advanced and retreated and species

have been introduced and exterminated, resulting in the present character and distribution of the flora, which is doubtless only a stage in the slow process of transition. The plants that constitute the present flora of the region have been drawn from various sources at different times. The xerophytic phase which occupies the lower and more open portions and by far the greatest part of the area belongs to the Sonoran province and was probably the last to invade the Davis Mountains region. Other associations found in the canyons of the higher mountains, about springs and under the bluffs of a few of the highest peaks are of more ancient origin and are relics from a time when more equable climatic conditions prevailed.

Beginning with the comparatively level rocky plains about Ft. Davis and on other sides of the mountains, which lie at altitudes of from 1200 to 1500 meters, several rather distinct zones of plant life may be distinguished, which become more restricted in area but better marked as the higher altitudes of the mountains are reached.

A flora consisting largely of grasses and herbs, in which species of *Bouteloua* and *Aristida* predominate, is found in the most open situations. Amongst common herbaceous species found here are *Polygala pubera*, *Phlox nana*, *Malvastrum coccineum*, *Sida neo-mexicana*, *Eryngium Wrightii*, *Cassia Roemeriana*, *Evolvulus linifolius*, *Solanum elaeagnifolium*, *Physalis hederaefolia*, *Monarda clinopodioides*, *Houstonia rubra*, *Helianthus ciliaris* and *Vernonia tenuifolia*. Mesquite bushes (*Prosopis juliflora* var. *velutina*), Yuccas (*Yucca constricta*), *Condalia obtusifolia*, *Opuntia imbricata*, *O. Engelmannii* and *Senecio Riddellii* are amongst the commoner shrubs. Some of these become more abundant along ravines or in broken rocky ground, where many other species also appear, and there is a gradual transition from this association to the richer and more varied flora of the foot-hills and lower canyons. Particularly characteristic plants along the dry arroyos and open rocky ground are *Koeberlinia spinosa*, *Microseris ericoides*, *Riddellia arachnoidea*, *Datura fastuosa* and *Xanthium spinosum*.

Rock ferns are abundant along cliffs and about the bases of the large erosion boulders of porphyritic rocks scattered about in the lower canyons and foot-hills. Fourteen species, mostly of *Pellaea*, *Notholaena* and *Cheilanthes*, were collected in one canyon within a half mile of Ft. Davis. *Woodia mexicana*, *Bommeria hispida*, *Asplenium resiliens* and the rare little *Polypodium thyrsanolepis* are also found here. The list of herbaceous flowering plants is long, but few of the species are common in any one locality, most of them being restricted to certain spots favored by peculiar conditions. Amongst plants found here that seem characteristic are *Andropogon scoparius*, *Aristolochia brevipes*, *Boerhaavia gypsophiloides*, *Linum australe*, *L. Lewisii*, *Acalypha Lindheimeri*, *Mentzelia oligosperma*, *Nicotiana trigonophylla* and *Siphonoglossa pilosella*. Many small trees and shrubs grow under the protection of the low bluffs and close along

canyon walls. Emory's Oak (*Quercus Emoryi*) and the narrow-leaved form of the Texas Red Oak (*Q. texana* var. *chisosensis*) are often common in such places, and with them grow the Mexican Mulberry (*Morus microphylla*), Hackberry (*Celtis reticulata*), *Sophora secundiflora*, *Ungnadia speciosa*, *Rhus virens*, *R. trilobata* and *Croton fruticulosus*. In somewhat more open situations the shrubby Juniper (*Juniperus monosperma*) is sometimes found, with such xerophytic shrubs as *Nolina texana*, *Dasyphyllum texanum*, *Yucca constricta*, *Ephedra trifurca*, *Metastelma plumosa* and *Bouvardia triphylla*. *Acacia tortuosa*, *Mimosa biuncifera*, *Mahonia trifoliata*, *Clematis Drummondii* and small groves of Emory's Oak often grow in open ground at the mouth of the canyons, and *Juglans rupestris* along the banks and beds of the dry streams. *Tecoma stans* var. *angustifolia* is common along rocky ledges. It is a shrub 6 to 8 decimeters tall, with a profusion of large trumpet-like flowers of a clear yellow color, which make it one of the most conspicuous and handsome plants during its long flowering period. Equally characteristic although less common are *Abutilon lignosum*, *Phlox Stansburyi*, *Croton suaveolens*, *Buddleia scordioides*, *Cissus incisa* var. *Andrewsii*, *Menodora longiflora*, *M. hispida*, *Brickellia californica*, *Baccharis californica*, *Eupatorium ageratifolium* and *Trixis angustifolia*. In more protected situations amongst the rocks and deep ravines *Philadelphus argyrocalyx*, *Fendlera rupicola* var. *falcata* and *Garrya Lindheimeri* are sometimes found, although they are more characteristic of higher altitudes. In some of the larger canyons where water remains for some time after rains various other trees and shrubs as well as herbaceous plants are sometimes found that usually grow only at higher levels, and a few species are most abundant here or are restricted to such places. Amongst the latter is the Maple (*Acer grandidentatum* var. *brachypteron*) and the Red Haw (*Crataegus Traceyi*). The former appears to be limited to these lower canyons while the *Crataegus* is most common here but is found up to levels of about 2000 meters. This tree is interesting as being the only representative of the large genus *Crataegus* so far found in the mountains of western Texas. It is a small thorny tree, often growing in groups or small groves. The largest specimens become 6 or 7 meters tall. At the lower levels the trees bloom early in April or perhaps even in March, depending on the season, but in the upper canyons I found it flowering as late as June 7th, in 1928. Amongst the other trees and shrubs found associated with the Maple and Red Haw are the Wild Cherry (*Prunus virens*), the Arizona Grape (*Vitis arizonica*), *Lippia ligustrina* and *Fraxinus texensis*.

Where the water supply is more abundant and permanent many other species begin to appear. In fact moisture everywhere appears to be the most important consideration and all evidence seems to indicate that many of the plants now restricted to the higher watered canyons, which will be described later, have been forced to retreat to such places to find protection and moisture.

In Limpia canyon, about a mile above the old fort, where the springs issuing from the gravel furnish perennial moisture for some distance, a very different association of plants is found. Although this locality is on about the average level of the plains many of the species growing here are found elsewhere only at considerably higher elevations in the mountain canyons. Many of the plants are limited strictly to the gravel bars of the creek or a narrow strip along its banks and they persist only as far as the influence of the water extends.

Typical trees and shrubs growing about the springs are *Populus Wislizeni*, *P. Macdougalii*, *Salix lasiolepis*, *S. Goodingi*, *S. longifolia* var. *angustissima*, *Juglans rupestris*, *Fallugia paradoxa*, *Fraxinus texensis*, *F. pubescens*, *Chilopsis linearis* and *Baccharis glutinosa*. Amongst the many herbaceous plants growing at this locality are *Cyperus esculentus*, *C. Fendlerianus*, *Lemna valdiviana*, *Tradescantia scopulorum*, *Commelina crispa*, *Froelichia gracilis*, *Radicula nasturtium-aquaticum*, *Sisymbrium diffusum*, *Euphorbia adenoptera*, *Polanisia uniglandulosa*, *Martynia fragrans*, *Epilobium Fendleri*, *Gaura parviflora*, *Salvia angustifolia* var. *glabra*, *Mimulus glabratus*, *Mecardonia peduncularis*, *Convolvulus incanus*, *Lobelia fenestrata* and *Pectis angustifolia*.

At an altitude of about 1700 meters (5500 ft.) the Piñon or Nut Pine (*Pinus cembroides* var. *edulis*) and the Alligator-bark Juniper (*Juniperus pachyphloea*) begin to appear on the slopes and tops of hills and both become commoner at higher altitudes, persisting nearly to the tops of the highest mountains. Sometimes in the Juniper-Piñon association the curious Century Plant (*Agave appplanata*) is found, sending up its flowering stalks to a height of five or six meters. The plants are said to take from 15 to 25 years to arrive at blooming size, and after once flowering the plant dies, reproducing itself by offsets. The Mexican name by which it is generally known in western Texas is Maguay, and an intoxicating liquor is made from the green stalks. Other woody species commonly found on the hills here are *Quercus grisea*, *Cercocarpus paucidentatus*, *Dalea formosa* and *Adolphia infesta*. *Phoradendron Coryae* and *P. juniperinum* are common parasites, the former growing usually on Mesquite and Oaks, and the latter on the Juniper. The flora of the canyons at this elevation is not greatly different from that found at the lowest levels in the region. Certain other plants, however, begin gradually to appear and others to become more abundant. The most conspicuous addition to the forest trees is the Western Yellow Pine, locally called Long-leaf Pine (*Pinus ponderosa*). At an altitude of about 1800 meters the first specimens are found in the open canyons and it becomes increasingly abundant as the higher levels, sometimes becoming dominant or growing in pure stands over small areas in the canyons and appearing on the steep open slopes of the mountains towards their summits. It is a fine tree, sometimes 25 meters or more in height and with a clear trunk for a third or half of the distance. The bark on younger specimens is usually

rough and deeply ridged, while on the larger trees it is divided into broad, flat plates. Some of the trees are infested with a parasitic shrub related to the Mistletoes, *Arceuthobium vaginatum*. Sometimes this is so abundant as to obviously injure or even to kill the trees.

At about the same level or a little lower such shrubs as *Ptelea polyadenia*, *Ceanothus Fendleri*, *Rhus copallina* var. *lanceolata*, *Forestiera pubescens*, *F. neo-mexicana* and *Lonicera albiflora* var. *dumosa* appear in the canyons, while *Quercus texana* var. *chisosensis*, *Prunus virens*, *Vitis arizonica* and *Arbutus texana* become frequent and often conspicuous members of the forest flora. *Sapindus Drummondii* is also sometimes found along bluffs, but it does not appear to be very abundant anywhere in the region. Along the gravel bars and beds of the streams the two Walnuts of the region (*Juglans rupestris* and *J. major*) are usually found, and the little Rosaceous shrub, *Fallugia paradoxa*, is common in such places. *Juniperus pachyphloea* and *Quercus Emoryi* also frequently grow along the rocky flood-plains and the latter attains its largest size (about 15 meters tall) in such places. If the water supply is rather more abundant some of the Willows and species of Ash may be present, and *Baccharis glutinosa* is frequent along the gravel bars or margins of pools. On the dry rocky slopes of the hills the Mountain Mahogany (*Cercocarpus paucidentatus*), and such low shrubs as *Eriogonum Wrightii*, *E. tenellum*, *Dalea frutescens*, *Opuntia polyacantha*, *Adolphia infesta* and *Carpochaete Bigelovii* are typical and common. Ferns continue to be abundant along the canyon walls, and in addition to the species found at the lower levels, *Pellaea cordata*, *Cheilanthes castanea* and *Woodsia Plummerae* become characteristic, and more rarely *Pellaea atropurpurea* and *Cheilanthes alabamensis* are found. Amongst the other characteristic or conspicuous herbaceous plants along the mountain streams are *Panicum plenum*, *Cyperus Rusbyi*, *Treleasea brevifolia*, *Aquilegia chrysanthia*, *A. longissima*, *Thelepodium Wrightii*, *T. linearifolium*, *Hosackia Wrightii*, *Astragalus giganteus*, *Hartmannia rosea*, *Lithospermum multiflorum*, *Geranium atropurpureum*, *Asclepias perennis*, *Hedeoma plicata*, *Pentstemon Torreyi*, *Cosmos parviflora*, *Bahia Bigelovii* and *Senecio Greggii*, to mention only a few. The tiny shrub, *Laphamia rupestris*, the succulent little *Sedum Wrightii*, the scarlet-flowered *Salvia Roemeriana*, and the scarcely less brilliant Indian Pink (*Silene laciniata*) are often found in the crevices of the canyon walls, the last species at least becoming commoner towards the tops of the mountains. On more open slopes such plants as *Amaranthus Pringlei*, *Mirabilis Wrightiana*, *Castilleja Lindheimeri*, *Cologania angustifolia*, *Artemisia mexicana*, *Picradenia longifolia* and *Gymnolomia multiflora* were noted. *Dichondra repens* is a common creeping plant on dry shaded banks, and a curious fungus-like parasite of the Broomrape family, *Chonopholis mexicana*, is often abundant on the roots of Oak trees. *Quercus hypoleuca* begins to appear in the canyons in the upper part of this association, although it becomes common only at higher altitudes where it is sometimes a dominant species.

In the upper part of the Limpia, Madera and other canyons leading up to Mt. Livermore a marked change in the character of the flora becomes apparent at an altitude of approximately 2200 meters. Many of the species of the lower zone persist but such conspicuous trees and shrubs as *Pinus flexilis* var. *reflexa*, *Quercus novomexicana*, *Q. undulata*, *Holodiscus dumosus*, *Rhamnus fasciculata*, *Symporicarpos oreophilus* and *Rosa Demareei* first begin to appear, and *Quercus hypoleuca* and *Rhamnus Purshiana* become conspicuous members of the plant association.

The White Pine (*Pinus flexilis* var. *reflexa*) is one of the largest and handsomest trees found in the Davis Mountains. It has a very different appearance from that of typical *Pinus flexilis* as it grows in other parts of the Rocky Mountains, and I am not sure that it should not be regarded as a distinct species. Some of the specimens seen in the canyons here must have been nearly 30 meters (90 to 100 ft.) tall. The trunks are straight and tall and the habit of growth is usually quite symmetrical. On the young trees the crown is slender-pyramidal, with whorls of branches at regular intervals. The larger specimens usually have a clear column-like trunk surmounted by a depressed conical head of rather short branches, the lower ones being somewhat pendulous. The bark is of a brownish color, rather deeply fissured and divided into large oblong plates. The bluish-green foliage has a beautiful plumose appearance, due to the long slender needles, 5 to 9 centimeters long, produced in fascicles of 4 or 5. The cones, which are pendulous, are cylindrical or narrowly conical, with truncate base and gradually tapering to the apex. They are usually 15 to 20 centimeters in length.

*Pinus ponderosa* and *Juniperus pachyphloea* are also common here and both attain a large size. In open situations the Juniper develops a low round crown of stout branches on the older trees. The short trunk is sometimes nearly a meter in diameter and the spread of the branches equals or exceeds the height of 18 to 20 meters attained by the largest specimens.

*Quercus hypoleuca* is often shrubby, forming dense thickets in some of the canyons and on rocky slopes. In more protected situations it becomes a tree up to about 14 meters tall. The leathery, lanceolate leaves, dark green above and white felty beneath, are evergreen and make it one of the most distinct looking of all the Oaks. *Quercus novomexicana* is also usually shrubby, growing in thickets in the canyons or on the open rocky slopes and along the base of bluffs at the highest altitudes. Occasionally single specimens occur that become small trees. *Quercus undulata*, which is much less common and found only towards the top of this zone and near the summits of the highest mountains, somewhat resembles the last species, but has narrower, less deeply lobed leaves, and it is usually a tree.

*Holodiscus dumosus*, growing on rubble and rocky banks towards the heads of canyons and ravines, is a conspicuous shrub in the flowering

season, which is in June or July, with its diffuse panicles of small white flowers. *Symporicarpos oreophilus* is a slender shrub, often pendulous or trailing over banks, especially about springs, or growing amongst rubble in the deep canyons. The small trumpet-shaped flowers, nearly a centimeter in length, are borne profusely in short racemes, and are of a pale pink or lavender color. It is almost equally attractive when in fruit, with an abundance of inflated white berries, usually a centimeter or less in diameter. It becomes even more abundant at the higher altitudes and is one of the commonest shrubs in the Summit Formation, as will be mentioned later. The Wild Rose and *Rhamnus fasciculata* are also more abundant towards the summits of the mountains. This species of *Rhamnus* usually grows along the base of bluffs, although it is sometimes found on the rocky banks of streams and on rubble-covered slopes at the higher altitudes. It is a much-branched shrub two or three meters tall, with rather small ovate-lanceolate leaves. *Rhamnus Purshiana*, which usually grows about springs or on moist banks, is a tree-like shrub with large broadly-elliptic feather-veined leaves. *Salix lasiolepis*, *Garrya Lindheimeri* and *Forestiera neo-mexicana* are also often common here.

Amongst herbaceous plants characteristic of this association, or at least commonest at the elevations where it occurs, are *Pteridium aquilinum* var. *pubescens*, *Muhlenbergia montana*, *Bromus Porteri*, *Epicampes leptoura*, *Spiranthes minutiflora*, *Acroanthes montana*, *Lathyrus graminifolius*, *Desmodium Grahamii*, *D. neo-mexicana*, *Oxalis monticola* ?, *Euphorbia chamaesula*, *Oenothera Hookeri*, *Pseudocymopterus montanus*, *Campanula rotundifolia*, *Phacelia crenulata*, *Heterospermum pinnatum*, *Solidago Bigelovii* and *Senecio integerrimus*.

Growing in clefts of the porphyritic rocks along cliffs and canyon walls are *Polypodium erythrolepis*, *Draba petrophila*, *Heuchera rubescens*, *Echinocereus Rosei*, *E. polyacanthus* and *Ferocactus hamatocanthus*. The Fern was seen only at one place near the head of Limpia Canyon. The other plants mentioned are often abundant and are found up to the highest cliffs of the mountains. *Echinocereus Rosei* is sometimes very conspicuous with its bright scarlet flowers that remain open only during the night or at least when protected from direct sunlight by shadows, or in cloudy weather. The ribbed, cylindric stems grow in dense caespitose clusters, often springing from clefts on the almost naked faces or ledges of the cliffs. *Ferocactus hamatocanthus* is much less common and seeks more protected situations. The deeply-ridged stem joints with long hooked thorns on elevated bosses grow in small groups or sometimes singly and attain a diameter of three or four decimeters in the older specimens. The flowers are of a clear lemon-yellow color, six to eight centimeters in diameter when expanded, which occurs only after sun-down or in deep shade.

Climbing up the steep grade towards the heads of the canyons as they

converge at the base of Mt. Livermore, and with indications of similar conditions about a few of the other higher peaks, a sudden and striking change in the flora is encountered. Here, at an altitude of about 2250 meters, accumulation of talus covers the steep slopes at the base of the perpendicular cliffs, which rise to a height of two or three hundred meters in places along the north and west sides of the peak. The loose material consists of blocks of all sizes up to two or three meters in diameter. Much of this is covered with moss and lichens, and in places considerable deposits of soil and humus have accumulated in depressions. Over part of the surface a dense growth of shrubs and small trees is found, the character of which indicates that a considerable amount of moisture must be received. The high cliffs above also furnish protection from the hot dry winds and from direct sunlight for a considerable part of the day.

The most conspicuous and largest tree is the western variety of the Trembling Aspen (*Populus tremuloides* var. *aurea*), of which there is a grove running up into an angle of the cliff on the north side of the mountain and following a ravine or draw down the talus slope for about a hundred meters. The largest trees are close to the foot of the cliff, where two or three attain a height of sixteen meters or more. Farther down the plants become smaller, gradually diminishing in size, and with the area they occupy narrowing, until the thin outer ranks are reduced to straggling shrubs only a meter or two in height. A large proportion of dead or partially dead plants indicates that the struggle they have to maintain in getting over periods of drought and other adverse conditions is rather severe and that a slight change for the worse might turn the scale against them.

The woody species found here, several of which are strictly limited to this narrow zone, while others occur slightly farther down the slopes and canyons, as has been mentioned previously, are:

<i>Populus tremuloides</i> var. <i>aurea</i>	<i>Prunus virginiana</i> var. <i>melanocarpa</i>
<i>Quercus novomexicana</i>	<i>Rosa Demareei</i>
<i>Quercus undulata</i>	<i>Rhamnus fasciculata</i>
<i>Quercus hypoleuca</i>	<i>Garrya Lindheimeri</i>
<i>Philadelphus argyrocalyx</i>	<i>Vitis arizonica</i>
<i>Philadelphus argenteus</i>	<i>Parthenocissus vitacea</i>
<i>Fendlera rupicola</i>	<i>Parthenocissus quinquefolia</i>
<i>Fendlera rupicola</i> var. <i>falcata</i>	<i>Forestiera neo-mexicana</i>
<i>Ribes leptanthum</i>	<i>Sambucus coerulea</i>
<i>Holodiscus dumosus</i>	<i>Symporicarpos oreophilus</i>
<i>Prunus virens</i>	

Along the foot of the high cliffs with north and east exposures the Male Fern (*Dryopteris filix-mas*) is very luxuriant in places, some of the fronds being eight or ten decimeters long. A few of the other characteristic herbaceous plants noted in this association are *Asplenium Tricho-*

*manes*, *Selaginella mutica*, *Smilacina* sp.?, *Allium cernuum*, *Urtica Breweri*?, *Thalictrum Wrightii*, *Draba petrophila*, *Heuchera rubescens*, *Corydalis* sp.?, *Aralia biuncifera*, *Erigeron Bigelowii* and *Chrysopsis hispida*. *Asplenium Trichomanes* is apparently rather rare, growing in deep shaded clefts along the cliffs, and the *Selaginella*, *Draba*, *Heuchera* and the two Composites are found in similar but somewhat more exposed situations and are more abundant. The other species were collected on the moist shady talus, to which they appear to be limited. The list represents only a small percent of the herbaceous flora at such places. At the same or higher altitudes on exposed slopes were found such plants as *Eriogonum Jamesii*, *Erysimum asperum*, *Androsace glandulosum*, *Sedum Wrightii*, *Phaseolus macropoides*, *Castilleja sessiliflora* and *Echinocereus viridiflorus*.

On the west side of Mt. Livermore, at about the same altitude, and under a cliff considerably higher than those on the north, a second grove of the Aspen with many of the peculiar associated plants was found. The area covered by this colony is greater and the number of plants composing it larger than at the other locality. The conditions at the two places are similar except for the greater exposure to the afternoon sun on the west side, but the thriftier appearance of the plants here, although none of them attain so large a size as the maximum trees under the north bluffs, indicates that this factor must be more than compensated for by other advantages. From the base of the cliff, which can scarcely be less than 300 meters in height, the Aspen has worked down two or three folds or ravines in the talus for a hundred meters or more and over the separating ridges and slope for a part of that distance, the plants gradually diminishing in size, as at the other station, towards the outer edge of the colony. The cliff here forms an open arc of a circle with the exposure slightly north of west. At the time of my visit, on June 4th, 1928, the early afternoon sun was beating down on the slope with intense fervor, and it seemed most astonishing that the *Populus* and some of the other species should be able to maintain themselves in such a position. The probable explanation is that a greater amount of moisture is actually received here than on the north side, due to the height and favorable location of the cliffs for intercepting saturated clouds and to the shade that they afford, except for a few hours near mid-day, which tends to produce and conserve a cool moist condition.

The *Ribes* and *Sambucus* and a few of the herbaceous plants so abundant on the north side were not seen here, while others, such as *Garrya* and *Rhamnus*, seemed to be thriftier and more abundant. Most of the other plants, except *Rosa Demareei*, were common to both places. This pretty little Rose, which was not seen under the north cliffs, although it occurs lower down in the canyons, was growing abundantly under the shade of the Aspens. Some of the plants here were over a meter tall, with stout prickly stems. The small pink flowers, which were in full

bloom, looked very striking and attractive in this peculiar setting. *Vitis arizonica*, *Parthenocissus vitacea* and the *Symporicarpos* were also trailing over and amongst the rocks, growing with the Rose under the Aspens, but they persisted also beyond the shaded area, where they flourished even more abundantly, with the Choke Cherry, *Rhamnus*, *Forestiera* and other shrubs. A little farther out, and obviously just beyond the protecting influence of the cliff, a xerophytic flora of *Nolina*, *Dasyliion*, *Yucca*, *Opuntia*, *Adolphia* and similar plants had full possession of the slope.

Near the top of Sawtooth Mountain, which lies several miles northwest of Livermore and rises to a height of 2350 meters (7748 ft.), the occurrence of several plants of this association in a deep protected cove at the head of a canyon indicates a former colony or an approach to the conditions that have made possible the persistence of this flora about the higher peak. The Aspen was not seen, although the inference is strong that it may have formerly been present with the other plants, such as *Quercus novomexicana*, *Prunus virginiana* var. *melanocarpa*, *Ribes leptanthum*, *Parthenocissus quinquefolia*, *Rhamnus fasciculata*, *Fendlera rupicola*, *Sambucus coerulea*, *Symporicarpos oreophilus*, *Dryopteris filix-mas*, *Allium cernuum*, *Smilacina* sp.?, *Aralia biuncifera* and several others that were growing here.

Since some of the plants both of the Transition and Canadian zones, the Upper Canyon and Summit Floras as here described, or species closely allied to them are widely distributed through the Rocky Mountains, and are clearly of northern origin; and since some of them reappear in the mountains to the south and far into the interior of Mexico, the inference seems obvious that the isolated colonies found in these outlying mountain groups, like the Davis Mountains, are relics of a widely distributed flora that once held sway more or less continuously throughout western North America. Climatic conditions that favored such a flora, suggestive of that now occupying the region about the Great Lakes and the central and southern provinces of Canada, must have been very different to those that prevail in the Southwest at present.

This sketch of the flora of the Davis Mountains and the annotated list of the woody species that follows is based upon observations and collections made during three brief visits in 1926 and 1928. The time at my disposal and the difficulties of travel and transportation in this rugged region made it impossible to explore more than a small part of it, and since every section visited and almost every canyon entered furnished surprises and additions to the list of plants, it is highly probable that other species growing within the limits of the area were not seen, and that further exploration might add materially to it.

While a number of botanists have visited the Davis Mountains region at various times and made more or less extensive collections of plants, no systematic exploration has so far been undertaken, nor has any general account of the flora appeared.

The earliest botanical information in regard to the region resulted from the explorations of Charles Wright, who in 1849 accompanied a military expedition from San Antonio to El Paso, which passed by the present site of Ft. Davis; and it appears that he must have gone some distance up the Limpia Canyon, since some of the plants in his collection are found only at the higher altitudes there. The plants of Wright's collection, including a number from our region, were described by Dr. Asa Gray under the title "Plantae Wrightianae."

Dr. Valery Havard, a surgeon of the United States Army, was in western Texas and visited the Davis Mountains region in 1881 to 1883, making valuable collections and notes on some of the conspicuous plants. A brief account of the country through which he passed and of the flora was written by him and published in Washington in 1885.

In 1887 to 1889 Mr. G. C. Nealley made collections of plants for the United States Department of Agriculture, mainly along the route followed by the United States and Mexican Boundary Survey about 40 years previously, and he appears to have visited the Davis Mountains region and collected in the Limpia Canyon.

Professors S. M. Tracey and F. S. Earle passed through the region between Toyahvale and Ft. Davis in the summer of 1902, making collections of Cacti and other plants. The type material of *Crataegus Traceyi* Ashe was collected by them in the northern part of the mountains on this trip.

Amongst other botanists who have made collections of plants in the region are Mr. D. M. Andrews, of Boulder, Colorado, who spent some time in the vicinity of Ft. Davis in the summer of 1913; Dr. B. C. Tharp, of the University of Texas, who has visited the region several times during the past few years with parties of botanical students, and Mr. W. W. Eggleston, of the Bureau of Plant Industry, Washington, who has investigated the poisonous plants of the area and made some general collections.

On my first trip to the Davis Mountains, in June, 1926, I was accompanied by Professor Delzie Demaree, of the University of Arkansas. We established our camp along the Limpia Canyon, on the Frank Jones ranch, at an altitude of about 1900 meters (6200 ft.). From this place we explored the main canyon and several smaller ones leading up towards Mt. Livermore. We spent one night near the top of the Mountain and climbed to the summit, exploring the cliffs on the east and south sides.

Mt. Livermore is not only the highest peak of the Davis group but it is the heart of the roughest and wildest part of the region. On the topographic sheets published by the United States Geological Survey this mountain is called "Baldy Peak," a name that is not recognized by the inhabitants of the region and which seems to have been coined by the surveyors who mapped the area. This has been responsible for considerable confusion on later maps, both names appearing in some

cases and giving the impression of two distinct peaks of equal altitude. Similar liberties seem to have been taken with some other well-established local names with no happier results either as to clarity or euphony. The summit of Mt. Livermore is occupied by a cone or ridge of almost naked rock rising about one hundred meters above the next lower stage. The summit is precipitous for most of its circumference and can be scaled with difficulty only on one side. A fine view of the surrounding mountains and canyons can be had from the top on a clear day. A few straggling shrubs of *Fendlera rupicola* and *Cercocarpus paucidentatus*, a Cactus (*Echinocereus viridiflorus*), and a sparse growth of grasses and xerophytic herbs manage to maintain themselves amongst the dry rocks at the very summit. Around the base of the cone a shrubby growth of *Quercus novomexicana*, *Prunus virens*, *Vitis arizonica* and a few other species is rather dense in places. Over more open spaces at this second level a shrubby form of *Quercus grisea*, with very small elliptic-lanceolate leaves, is the dominant plant. Some of the plants are less than a meter tall and spread over much wider areas with a dense growth of foliage and branches.

On this trip we spent six days in the mountains and in the vicinity of Ft. Davis, following the Limpia down all of the way from our mountain camp to the town on our return. The weather was fine during our stay, although rather dry, and we made a large collection of plants, the flora generally being in good condition.

A second trip in coöperation with the Botanical Department of the University of Texas was made in the autumn of the same year, my companion being Mr. A. H. Berkman, then a graduate student at the University. Fortune was not so favorable to us in some respects on this trip. We encountered bad roads and tire trouble on the way from Austin to Ft. Davis, and were delayed at the latter place by a heavy rain. On our way out to the mountains, in trying to follow the poorly-marked winding roads through the ranches, we were overtaken by darkness and torrents of rain and were compelled to wait for daylight before extracting our car from the deeply-rutted roadway where it had stalled in the mud.

The following morning we established our camp at the Rock-pile Ranch, near Sawtooth Mountain, and spent the next two days in exploring the vicinity. On October 5th, having gone as far as we could with the car, we left it in a valley and set out on foot with collecting outfit, blankets and other supplies, to make our way over the mountains to Livermore peak, which I was anxious to explore from the north side. The direct distance was only a few miles, but the nature of the country greatly increased this and made traveling with loads quite difficult in places. The first night we slept by a mountain stream, the murmuring of which, mingled with the rustling of the Pines above us, the distant cry of the Whip-poor-wills and other forest sounds made pleasant music, and our camp fire of cedar logs, casting strange shadows beyond the little circle

of light, added to the charm of the scene as well as to our comfort through the chilly night. The next morning, however, a light rain began falling, which became heavier as we proceeded, and the temperature fell rapidly. Leaving our blankets and as much of our other loads as we could dispense with under a dry ledge of rock, we continued climbing and accumulating a large collection of plants as we went. Some distance below Mt. Livermore we struck into the upper part of Madera Canyon, which we followed to the foot of the mountain. Coming out under the high cliffs on the north side of the peak we spent some hours of difficult climbing through the wet shrubs and over slippery rocks in an unsuccessful attempt to find a place where we could scale them and reach the top. Although thoroughly soaked and chilled we kept on collecting as many interesting things as we could lay hands on, but towards the end of the afternoon a heavy blanket of fog and cloud settled down over the mountain so that it became impossible to distinguish any distant landmarks or to see more than a few meters ahead. Making our way as best we could back down the mountain side we managed after some difficulty to locate our blankets and other things and began seeking for a dry cave or ledge under which to spend the night, as it was evident that we would not be able to get back to the car. We crossed a rocky ridge into another deep canyon, where finding ourselves completely at fault as to direction, and darkness coming on, we were forced to stop for the night. It was at this point, just as the light was failing, that I found the interesting little Orchid, *Acroanthes montana*, growing amongst the humus and Oak leaves.

After much delay we managed to get a fire started by splitting dry wood from the heart of a Cedar log, and the rain fortunately slackening a few hours later we were able to dry our clothes to some extent by it. The ground and rocks, however, were soaking wet and we got little sleep as we crouched over the camp fire and kept it going waiting for the day-light. The mournful cries of a pair of bob-cats that kept circling our camp in the trees, evidently attracted by the camp fire, added nothing to the inducements for sleep.

The next morning Berkman climbed to the top of a high hill to try to locate Sawtooth or other landmarks and determine our location and directions. But the clouds still lying low on the mountain tops he was unsuccessful in this.

In the meantime I explored the canyon in the vicinity of our camp. *Juglans major* was growing along the bed of the mountain stream, some of the trees being eight or ten meters in height and with abundant fruit. *Forestiera pubescens* and *Mahonia haematocarpa* were growing on the steep rocky banks. The last seems to be rather a rare shrub in these mountains. One of the specimens seen some distance farther down this canyon was between four and five meters tall and with stems a decimeter or more in diameter, making it one of the largest of the Barberries.

Fearing to get lost in the mountains we decided to follow this canyon

out to the plains, in the hope that it might lead us somewhere in the direction of our car or camp. The Wild Cherry (*Prunus virens*) and the Wild Grape were common in the canyon and both were loaded with fruit. The black bears, of which there were abundant signs everywhere, although they kept pretty well out of sight, had broken down the lower branches of the trees and the vines in many places to get at the fruit.

Our provisions had been exhausted the previous evening and we set out without breakfast, and the heavy rain-soaked loads we were carrying proved very troublesome in rough places. Towards noon we reached the open country a few miles from our car and after regaining the latter we were soon at camp, where we prepared and did ample justice to our first real meal in forty-eight hours, the menu including a few mushrooms (*Agaricus* sp.?) which I found growing in the pastures.

In the spring of 1928 I planned another trip into the Davis Mountains. Arriving at Alpine on April 20th, I was met by Mr. Leo T. Murray, then Superintendent of Schools at Ft. Davis, who drove me over to that little mountain town. I learned there that the season was very backward and dry and that recent severe frosts had killed back such vegetation as had put out in the vicinity of the town, and subsequent investigation proved that most of the vegetation in the mountains was still quite dormant.

The following morning we set out for the mountains, stopping first at the Fowlkes ranch, some fifteen or twenty miles from Ft. Davis, where the Little and Big Aguja Canyons begin within a few hundred meters of each other.

About the spring at the head of the Big Aguja *Salix lasiolepis* was growing, the trees having staminate flowers at this time, although the leaves showed evidence of frost. *Rhus copallina* var. *lanceolata* growing nearby was still dormant. Going a mile or so down the canyon we found little evidence of new growth on trees and shrubs and even less in herbaceous plants. *Quercus hypoleuca* was common and conspicuous with its evergreen coriaceous leaves, and the Madrona (*Arbutus texana*), which also retains its leaves through the winter, had already bloomed. A little farther down the Maple (*Acer grandidentatum* var. *brachypteron*) was abundant. This species, as it grows here, is a shrub or small tree attaining a maximum height of six or seven meters, with short, usually crooked stems and branches and pale smooth bark. The leaves had put out evidently some weeks previously, probably following showers and a period of warm weather. Some of the trees also had half-grown fruit, but leaves and samaras had in most places been severely nipped by recent frosts. *Crataegus Traceyi* was also abundant here, some of the plants being in bloom.

In returning up the canyon we caught sight of a group of small Plum bushes growing along the rocky banks of the stream. This appears to represent a new and distinct species, which is described at another place

in this paper as *Prunus Murrayana*, for Mr. Leo T. Murray, who was with me when it was discovered. Subsequently I found what appears to be the same species growing in a little dry canyon near Ft. Davis, the plants at the latter station being without flowers or fruit.

Crossing over to the Madera Canyon, we followed a mountain road past the Fischer ranch to a point several miles below Livermore Peak, and as far as we could proceed with the car. The last few miles of the way was steep and difficult and little more than a trail, and as night was coming on we made camp in the canyon, where the temperature fell nearly to the freezing point before morning. The next morning we set out on foot up the canyon towards Mt. Livermore. There was little in condition to collect except the Conifers and other evergreen trees and shrubs. *Pinus ponderosa* was common a little way above our camp, and some of the trees were badly infested with the parasite, *Arceuthobium vaginatum*, which was both in flower and fruit. Another Mistletoe, *Phoradendron juniperinum*, was also common on the large Juniper (*Juniperus pachyphloea*).

A cold misty rain began to fall in the canyon and we could see from the more open places that the top of the mountain was enveloped in a heavy fall of sleet. As the sun came out later the trees and shrubs encased in ice at the higher altitudes shone out with striking brilliancy, but when we finally reached the top shortly after noon it was rapidly melting and the ice was falling thickly in the strong wind.

Realizing that it would be useless to spend much time in the mountains under these conditions, we returned to Ft. Davis and I spent some weeks collecting in other parts of Texas before returning to this region at the beginning of June.

At this time Mr. Murray and I again went up the Madera Canyon, and by carefully picking our road amongst rocks and other obstacles we managed to reach a point with the car more than a mile above our former camp. Carrying the tent, supplies and outfit a piece at a time up the steep trail for half a mile farther I selected a camp site at a beautiful spot on a flat bench between the creek and a rocky bluff. The place was well shaded and abundantly supplied with wood, and the base of the cliff furnished a ready-made fireplace and kitchen shelves. The most serious disadvantage was the scarcity of water. A little muddy pool in the bed of the creek, much frequented by cattle and wild animals, was the only ready source of supply. This was so stagnant and vile that it was scarcely fit to use even for washing purposes. However, a light shower came on before I had my tent set up and more rain that fell during the night helped to solve the water problem temporarily, for in the morning I found water caught in the hollows of the rocks, which furnished me a supply for about two days.

After helping to set up the tent my companion, who had to return to Alpine, left me and I managed to get most of my things under shelter

before dark. I knew that there was a spring somewhere up the canyon, but when I had a chance to reconnoiter the following day I found that it was nearly three miles up to it over a steep and rugged trail. But this being the nearest source of supply after the rain water was exhausted I was obliged to make the journey to it with my canteens each day.

Early in the morning I was on the trail towards Mt. Livermore. In the month since my last visit there had been some progress in the development of the vegetation, but since only light rains had fallen and the weather had generally remained cool, things were still surprisingly backward, and except in the more sheltered parts of the canyons many trees and shrubs were as dormant as in winter.

The spring, which is located near the head of the canyon and not far below the foot of the mountain, was now reduced to a tiny trickle, and as it required nearly a quarter of an hour to fill a quart canteen the process of obtaining the precious fluid was somewhat tedious. *Rhamnus Purshiana*, *Salix lasiolepis*, *Symphoricarpos oreophilus*, *Quercus novomexicana* and some fine large trees of *Pinus flexilis* var. *reflexa* were growing about the spring, but most of the herbaceous plants which are abundant in more favorable seasons had now succumbed to drought and browsing animals. The spring is much frequented by wild animals as well as by the cattle, as was attested by the numerous fresh tracks of bear, deer and various smaller sorts. Frequently in coming up the trail I caught glimpses of both the large Mule Deer and the smaller White-tail or Flag-tail species, and once or twice I saw Bruin or his spouse scurrying to cover. The spring is also a favorite rendezvous for many kinds of birds, some of which, including a species of mountain Pigeon, apparently nest in the vicinity. Rattlesnakes are rather abundant here and throughout the mountains, and one has to be on the lookout for them everywhere. On my first trip up this canyon I killed two, one of them being a large specimen of the common Mountain Blacktail species and the other a slender stone-colored snake with dark bands and very small rattles.

A little way below the spring *Ceanothus Fendleri* was in bloom along the rocky creek bed, and *Rosa Demareei*, growing on a sometimes moist bank, was also flowering. Climbing up the steep slope to near the foot of the cliffs I found *Sambucus coerulea* in full bloom. Some of the plants were four or five meters in height and quite tree-like, with trunks more than a decimeter in diameter. On some of them the narrow leaflets were deeply serrate or almost laciniate, perhaps representing a distinct form. *Philadelphus argyrocalyx* and *Fendlera rupicola* var. *falcata* were also in bloom and the Choke Cherry was setting young fruit, but the Gooseberry was not yet in flower. Owing to the dry season there was little in the way of herbaceous growth except a species of *Stellaria* and a *Corydalis*, growing amongst the rubble, and several flowering plants and ferns in clefts along the bluffs. The Male Fern was also conspicuous in places but had made little new growth. A light shower came up about

noon, mingled with some fine hail, and as the vegetation became wet a large species of snail with thin striped shell began to emerge from the bases of the ferns and from under the mossy rocks and beds of *Selaginella*.

On another trip I crossed the mountains some distance northwest of Livermore and after a circuitous climb over the high ridges came out into a deep canyon between that peak and Sawtooth Mountain. *Rhamnus fasciculata* was abundant along some of the cliffs and I also came upon *Quercus undulata* near the top of a high bluff. A large Juniper tree in one of the canyons looked very puzzling. The top of this tree had been broken down in a storm and only a few of the lower branches were alive. From these I secured specimens of the leaves and fruit which clearly showed it to be the common species of the mountains, *Juniperus pachyphloea*, although the bark of the trunk, which was nearly a meter in diameter, was rather smooth and shreddy and not at all like the usual rough checkered bark of this tree. I saw a few other trees with similar though not quite such smooth bark at other localities. In descending into the canyon I found *Garrya Lindheimeri* and *Forestiera neo-mexicana* abundant in some of the deep ravines, and at one place *Mahonia haematocarpa* was in bloom, the flowers being of a bright yellow color.

Working my way back towards the south side of Livermore I came to the head of a deep canyon which is scarcely indicated on the topographic map. This ran towards the east and descended rapidly between high walls, forming a narrow gorge. I followed it down for about a mile, at which point *Fraxinus texensis*, *Juglans major* and *Vitis arizonica* began to appear. I believe that this is the same canyon that Demaree and I explored for some distance from the other direction two years previously, and in the lower end of which we found *Quercus reticulata* and the Bittersweet (*Celastrus scandens*).

As time did not permit me to follow this interesting canyon farther on this trip, I returned along the south side of the mountain to the western end, where with much difficulty I climbed up the steep slope to the base of the high cliff and found the grove of Trembling Aspen, which has been described in another place.

A few days later I crossed over the divide into the head of Limpia Canyon, which I followed down to a point below our first camp on the Jones ranch. Not finding anyone about the little ranch house I spent the night in the canyon by a camp fire. Conditions were much drier in the canyon at this time than we had found them in 1926. None of the springs were flowing and all water had disappeared at the higher levels and only at two or three places did I come upon water holes where I could replenish my supply. On dry open slopes some of the trees and shrubs still showed no sign of putting out new foliage, and herbaceous plants were very little in evidence except at a few spots. *Erysimum asperum* was in bloom along dry ledges near the top of the mountain and farther down in the canyon *Aquilegia chrysantha*, *Hartmannia rosea*,

*Senecio Greggii* and a few others were in flower. Below the altitude of about 2000 meters *Mimosa biuncifera*, *Ceanothus Fendleri* and *Rhus copallina* var. *lanceolata* began to appear in the more open parts of the canyon. A little lower down *Astragalus giganteus* was in bloom on the gravel bars. On my way back up the steep trail I stopped to look for the little Orchid, *Spiranthes minutiflora*, that we had found on the previous trip growing in a bit of boggy ground about a spring, but the place was now quite dry and no signs of the rare plants were to be found. Well up towards the top of the mountain, on a slope where water evidently seeps out in rainy seasons, a few flowering stalks of the Coral Root Orchid (*Corallorrhiza maculata*) had persisted from the previous year but the new growth had not started. Not far below along a low porphyritic bluff of the canyon I found an abundant growth of a curious little fern, *Polypodium erythrolepis*, a Mexican species recently described by Weatherby, and which does not appear to have been found previously in the United States. This was growing with *Selaginella Sheldoni*. The coriaceous fronds are ovate-lanceolate and entire with obtuse or rounded apices.

After returning to Ft. Davis and spending a day collecting in the foothills there I made a hasty trip to the Little Aguja Canyon. We followed the Toyahvale road down the Limpia Canyon for some miles, and then made our way over the pasture roads through the McCutcheon ranch to the mouth of the Little Aguja. The altitude here is considerably lower than in the other parts of the region that I had visited, being under 1400 meters in the plain. A xerophytic flora of Cacti, Yuccas, Sotol, Creosote-bush (*Covillea tridentata*) and the Tar-bush (*Flourensia cernua*) occupied the flat sterile land at the foot of the hills. The supply of water issuing from the canyons was used in a small way for irrigation on the ranch, and some small fields of Maize and forage crops were in cultivation. We managed to get our car up the canyon for several miles, but the last part of the road was rough and difficult. When we could go no farther I left the driver and car at a small abandoned house near a water hole and proceeded on foot. As the canyon narrowed and the walls became higher the flora rapidly became more varied and interesting. *Quercus Muhlenbergii* was growing just below the first water hole and it became abundant a few miles farther up. *Acer grandidentatum* var. *brachyterum* was found under the bluffs and along the rocky creek bed. Several of the other Oaks were also seen, *Quercus grisea* and *Q. Emoryi* growing in the more open places and *Q. texana* var. *chisosensis* and *Q. hypoleuca* occupying ground closer to the creek or in the protection of bluffs, and *Prunus virens* and *Crataegus Traceyi* were frequently growing with them. There was more water here than in any of the other canyons I had explored. In many places the creek was flowing and there was a succession of water-holes for several miles. In some of these fish were very abundant and they could be seen clearly disporting amongst the

rocks through the limpid water. As usual in such places *Salix lasiolepis*, *Juglans rupestris* and *Fraxinus texensis* were growing about the pools, as well as many species of grasses, sedges and herbaceous plants. A large Cottonwood tree (*Populus Wislizeni*) was growing near a slender needle-like pinnacle of porphyry, perhaps 20 or 25 meters tall, which has doubtless suggested the Spanish name of the canyon. *Garrya Wrightii*, also growing near here on the cliffs and rocks, was a species I had not collected before. Along a wet bank there was a rank growth of the Virginia creeper (*Parthenocissus quinquefolia*) and Wild Grape, with Columbine, Water Pimpernel (*Samolus floribundus*), *Ludwigia palustris* and other hydrophytic plants along the margin of the pool at the base, and grasses and a variety of mesophytic herbs higher up. In a wet season the vegetation must be rather rank at this place. The little Poison Ivy (*Rhus Rydbergii*) was found close-by on a low rocky bank. Towards the head of the canyon a few specimens of *Pinus ponderosa* began to appear and the Piñon was seen at several places. The altitude, however, seems to be too low for *Pinus flexilis* var. *reflexa* or any of the characteristic species of the Summit Formation found about Mt. Livermore.

Most of the woody plants found in the other canyons except those restricted to the highest altitude were noted in the Little Aguja, although it is unnecessary to give the entire list, and the discovery here of several species not found elsewhere in the mountains indicates that this part of the region may offer the most promising field for further investigation.

The literature in regard to the botany and natural history of the Davis Mountains region seems to be rather meager, although references to it are found in a number of more general treatises. Some of these, a list of which is given at the end of this paper, I have had occasion to consult and have availed myself freely of the information which they contain.

I must here acknowledge my indebtedness to my traveling companions on the various trips, whose energy and courage were in large measure responsible for what was accomplished. I also wish to express my gratitude to the authorities of the Morton Arboretum for coöperation with the Arnold Arboretum in promoting these trips, and to the botanists of the University of Texas for their interest and assistance in the work. Many of the citizens of Ft. Davis and the ranchers in the country visited also showed in many ways their intelligent interest in promoting scientific work in the region, and I am under obligations to them for courtesies and hospitality. It would scarcely be fair in this connection not to mention the fine survival of pioneer hospitality, which still prevails on many of the great ranches, where the stranger is welcomed and extended every courtesy at their command.

Specimens of some of the plants have been submitted to botanists who have made special studies of difficult groups, and I wish to thank all of them for their assistance. Amongst these I would specially mention Professor A. S. Hitchcock and Mrs. Agnes Chase, of the Bureau of Plant

Industry, Washington, who have identified or passed on most of the Grasses; Dr. S. F. Blake, of the same bureau, who has examined some of the Composites; Dr. William R. Maxon, of the National Museum, and Mr. C. A. Weatherby, of the Gray Herbarium, for assistance on the Ferns, and Dr. Francis W. Pennell, of the Academy of Natural Sciences, Philadelphia, who has examined and determined some of the *Scrophulariaceae*.

Specimens of all of the ligneous plants of the following list are deposited in the herbarium of the Arnold Arboretum and in that of the Morton Arboretum. Specimens of many of the woody as well as of the herbaceous species will also be found in the herbaria of the Missouri Botanical Garden, the New York Botanical Garden, the University of Texas, and other institutions.

#### LIGNEOUS PLANTS OF THE DAVIS MOUNTAINS

##### PINACEAE

*Pinus ponderosa* Dougl. In mountain canyons from an altitude of approximately 1800 meters and on mountain slopes from about 2000 meters to the summits. This tree sometimes grows in pure stands over small areas or as a co-dominant species with *Juniperus pachyphloea*. It is one of the most valuable timber trees of the region.

*Pinus cembroides* var. *edulis* (Engelm.) Voss. The Piñon is a small tree attaining a maximum height of about 12 or 15 meters as it grows in the Davis Mountains. It is found in open canyons and on mountains from about 1700 meters to the highest altitudes. On dry and sterile mountain tops plants a meter or less in height are sometimes loaded with cones. The wood of this species is of little value and few of the seeds mature in the cones.

*Pinus flexilis* var. *reflexa* Engelm. This tree is found only in the higher canyons and on slopes near the summits of the mountains, usually above an altitude of 2200 meters. It is a beautiful symmetrical tree attaining a maximum height of about 30 meters. The wood is valuable for lumber but it is too rare and inaccessible in this region to be of much commercial importance.

*Juniperus pachyphloea* Torr. The Alligator Juniper grows in open canyons and on mountain sides above an altitude of about 1700 meters. The wood is used for posts and other purposes.

*Juniperus monosperma* Engelm. This species is comparatively rare in the region, where it grows in the foot-hills and on the lower mountain slopes. It is usually shrubby and of no economic importance.

##### GNETACEAE

*Ephedra trifurca* Torr. This curious shrub, with its green stems and whorled leafless branchlets, is frequent in dry rocky ground in the plains and foot-hills and sometimes on the lower mountain slopes.

## LILIACEAE

*Nolina texana* Wats. This low shrub, known in the Southwest as Bear Grass, is found in the foot-hills and along dry rocky cliffs of the lower mountains.

*Dasyllirion texanum* Scheele. The Sotol is found on rocky plains and hillsides at the lower altitudes. In the Davis Mountains region it is nowhere common enough to be of economic importance as a forage plant, as it is in some other sections.

*Yucca elata* Engelm. This species is found only in the plains and foot-hills. The plants are seldom over two or three meters tall at this altitude.

*Yucca constricta* Buckley. This low species is often abundant in open rocky ground in the plains and foot-hills. It is sometimes nearly acaulescent and resembles closely *Yucca glauca* of the western plains.

*Yucca macrocarpa* (Engelm.) Coville. This is the commonest *Yucca* of the region, growing in open rocky ground on the plains and lower slopes of the mountains. It seldom grows to a height of more than two or three meters here.

## SALICACEAE

*Salix lasiolepis* Benth. Grows along streams and about springs in the mountain canyons up to altitudes of 2200 meters. This is the most abundant Willow in the region and the only species found at the higher altitudes. It is usually a shrub with a maximum height of five or six meters. The bark is smooth and the branches are of a yellow-green color.

*Salix taxifolia* H.B.K. Found along streams and in open canyons at the lower altitudes and up to about 1700 meters. This species sometimes becomes a tree 12 to 15 meters in height. It is easily recognized by its small leaves and by the rough, deeply ridged bark on the trunks of old trees.

*Salix Goodingii* Ball. This species is growing along Limpia Creek, near Ft. Davis, where it may have been planted, and it was also seen in the Little Aguja Canyon. It sometimes becomes a large tree with dark rough bark, and it seems to be closely related to *Salix nigra*, the common Black Willow of wide distribution.

*Salix longifolia* var. *angustissima* Anders. This variety of the Sandbar Willow was found growing along the creek near Ft. Davis, where it may have been introduced.

*Populus tremuloides* var. *aurea* (Tiedst.) Daniels. The Trembling Aspen is limited in the Davis Mountains, so far as known, to two small groves under the high cliffs near the top of Mt. Livermore. It is a small tree, the largest specimens attaining a height of 14 or 15 meters.

*Populus Wislizeni* Sarg. This species is common along the Limpia, near Ft. Davis, and it was also noted at the lower levels in some of the other canyons. Although the trees about the old fort and the town are said to have been planted it is probably native in the region.

*Populus Macdougalii* Rose. Trees that appear to belong to this species, which was previously known to range from Arizona to California, are growing with the last along Limpia Creek.

#### JUGLANDACEAE

*Juglans rupestris* Engelm. This small-fruited Walnut is common along the rocky flood-plains of streams and in their vicinity from the lowest levels to about 1900 meters. It is often shrubby but becomes a tree up to 7 or 8 meters tall.

*Juglans major* (Torr.) Heller. This species grows with the last, but is more common at the higher altitudes up to about 2000 meters. It is usually a tree, with a maximum height of 10 or 12 meters, and may be distinguished from *Juglans rupestris* by its larger fruit and the broader and less numerous leaflets.

#### GARRYACEAE

*Garrya Lindheimeri* Torr. A slender shrub rarely two meters in height. It is found along rocky bluffs and in deep canyons from the altitude of Ft. Davis to that of the highest mountains.

*Garrya Wrightii* Torr. This species was collected only in the Little Aguja Canyon, where it was growing on rocks and cliffs, but it probably occurs at other places in the mountains.

#### FAGACEAE

*Quercus grisea* Liebm. The Gray Oak is one of the commonest species of the Davis Mountains region, and it is found growing from the plains to the tops of the highest mountains. It is extremely variable in its foliage and habit of growth. At the lower levels it becomes a tree, with a wide flat crown, sometimes 10 or 12 meters tall. A dwarf form occurs on the high mountains, which often forms dense thickets, and in which the plants are sometimes a meter or less in height. The wood of the larger trees is used for fuel.

*Quercus novomexicana* (DC.) Rydb. This species is found only above an altitude of approximately 2100 meters in the canyons and at one or two hundred meters higher along cliffs of the mountains up to the highest levels.

*Quercus Muhlenbergii* Engelm. The Chinquapin Oak seems to be confined to the northern part of the region. It is rather abundant in the upper part of the Little Aguja Canyon, and I have also seen specimens collected near the mouth of Madera Canyon and on Mt. Gomez.

*Quercus undulata* Torr. A species found only at the higher altitudes of 2200 meters and above, where it grows sparingly in canyons and on rocky mountain slopes. In foliage and general appearance this species somewhat resembles the last, but it becomes a larger tree, sometimes up to 18 or 20 meters in height.

*Quercus reticulata* H.B.K. This appears to be a rare tree in the Davis

Mountains region, having been noted only in one small, deep canyon a little to the east of Mt. Livermore

*Quercus hypoleuca* Engelm. Growing in the canyons in the area about Mt. Livermore at altitudes above approximately 1700 meters and at somewhat lower levels in the Little Aguja Canyon. In protected situations it sometimes becomes a small tree up to 12 or 14 meters tall, but it is more commonly a shrub only two or three meters in height.

*Quercus Emoryi* Torr. This is perhaps the commonest Oak found at the lower altitudes and up to approximately 2100 meters in open canyons. It sometimes becomes a tree, with symmetrical round crown, and a maximum height of about 15 meters. The wood is tough and durable and is used for fuel and posts.

*Quercus texana* Buckley. The typical form of the Texas Red Oak is comparatively rare in this region. A few specimens were seen in the lower canyons where it grows with the variety next mentioned.

*Quercus texana* var. *chisosensis*<sup>1</sup> Sarg. This form is common in all of the lower canyons, but it does not seem to be present above 2000 or 2100 meters elevation. It is a small tree with a maximum height of about 16 meters. The leaves in the variety are narrower than in the typical form but they are extremely variable on different trees.

*Quercus texana* var. *stellipila*<sup>1</sup> Sarg. In the type specimens of this variety, the leaves are rather broad and with short obtuse lobes, but forms with similar pubescence but the narrow leaves of var. *chisosensis* were found which should perhaps be referred to it.

*Quercus inconstans*, nov. hyb. (*Quercus Emoryi* × *hypoleuca*). Wh... appears to be a hybrid between these two species was collected in a deep rocky canyon a little east of Mt. Livermore. The leaves have a pale felty pubescence on the under surface similar to that of *Q. hypoleuca*, but it is thinner and rather easily rubbed off. In form and texture the leaves are also intermediate between the two supposed parents, both of which were growing near the hybrid. Collections were made from two plants growing some distance apart. My numbers referred to this hybrid are 30934 and 30935.

#### ULMACEAE

*Celtis reticulata* Torr. This is the commonest species of Hackberry in the region, and it is rather frequent along rocky streams in the canyons of the foot-hills and lower mountains, becoming rarer at the higher altitudes. In the canyons it sometimes becomes a tree with a maximum height of 12 or 14 meters, but in drier situations it is usually shrubby.

*Celtis laevigata* var. *texana* (Scheele) Sarg. This form is sometimes found along rocky bluffs and banks in the canyons at the lower and middle altitudes.

<sup>1</sup> In the original description of this variety (Sargent in Bot. Gaz. LXX. 423 [1918]) the name was spelled *chesosensis*, which is an obvious error that should be corrected; also var. *stellapilla* Sarg. (l. c. 424) should be corrected to *stellipila*.

*Celtis laevigata* var. *brevipes* (Wats.) Sarg. A usually shrubby form, growing in similar situations to the last.

#### MORACEAE

*Morus microphylla* Buckley. The Mexican Mulberry is found only in the lower canyons and foot-hills, where it is usually shrubby.

#### LORANTHACEAE

*Phoradendron Coryae* Trel. This seems to be the commonest Mistletoe of the region, growing on a variety of host plants, including most of the Oaks, *Acacia* and *Prosopis*. Trees of *Quercus grisea* and the Mesquite are often badly infested and in some cases are eventually killed by it.

*Phoradendron Engelmannii* Trel. This species somewhat resembles the last and grows on the same hosts. It can generally be distinguished by its smaller fruit and smaller, roundish leaves.

*Phoradendron juniperinum* Engelm. This species is often abundant on *Juniperus pachyphloea*.

*Arceuthobium vaginatum* (H.B.K.) Eichl. Parasitic on *Pinus ponderosa*, and apparently commonest at the lowest altitudes at which that species occurs.

#### POLYGONACEAE

*Eriogonum tenellum* Torr. On rocky ledges and slopes of the foot-hills and lower mountains.

*Eriogonum Jamesii* Benth. This species grows in similar situations to the last, but is usually found at higher altitudes.

*Eriogonum Wrightii* Torr. This species is found on dry rocky slopes and bluffs at the lower and middle altitudes.

#### PHYTOLACCACEAE

*Rivina humilis* L. In rocky ravines and canyons at the lower altitudes.

#### BERBERIDACEAE

*Mahonia trifoliata* (Moric.) Fedde. This shrub, known by the Mexican name of Algerita, is found only in the plains and foot-hills and is rather uncommon.

*Mahonia haematocarpa* (Wooton) Fedde. This species appears to be comparatively rare in the region and was seen only in some of the higher canyons above the altitude of 2000 meters.

#### RANUNCULACEAE

*Clematis Drummondii* Torr. & Gray. A slightly woody vine, climbing or trailing over shrubs and rocks, found only in the foot-hills and lower canyons.

*Clematis reticulata* Walt. This species is found in the canyons along the banks of streams. It is a climbing vine, and is less common than the last.

## SAXIFRAGACEAE

*Philadelphus argenteus* Rydb. A shrub one to three meters tall, found in the canyons and on rocky banks at all elevations, but most abundant on the high mountains.

*Philadelphus argyrocalyx* Wooton. A shrub somewhat resembling the last species in habit and growing in similar situations.

*Fendlera rupicola* Gray. A shrub found along rocky banks and bluffs in the canyons, but most common near the summits of the mountains.

*Fendlera rupicola* var. *falcata* (Thurber) Rehder. This variety is quite similar to the last except in the narrower and sometimes falcate leaves. It grows in similar situations to the typical form and is much commoner.

*Fendlera Wrightii* Gray. This species was seen only in the Little Aguja Canyon, where it was growing on rocky ledges along the canyon walls.

*Ribes leptanthum* Gray. This Gooseberry is one of the plants restricted to the highest altitudes and is characteristic of the Summit Formation. It was seen only on Sawtooth and Livermore Mountains.

## ROSACEAE

*Holdiscus dumosus* (Nutt.) Heller. A diffuse shrub locally common at the heads of ravines and canyons and on rocky banks at altitudes of about 2100 meters and above.

*Fallugia paradoxa* (Don) Endl. This slender shrub is often abundant along the beds and banks of rocky streams, from the plains to about 2100 meters.

*Cercocarpus paucidentatus* (Wats.) Britton. The Mountain Mahogany is a common shrub on open slopes and ledges, especially at the higher altitudes.

*Crataegus Traceyi* Ashe. This species of Red Haw, the only one seen in the Davis Mountains, is common in many of the canyons especially at the lower altitudes and up to about 2000 meters. It is often shrubby but sometimes becomes a tree up to 6 or 7 meters tall. Specimens from the Edwards Plateau, which undoubtedly belong to the same species, were described by Professor Sargent under the name of *Crataegus montivaga*, which must be regarded as a synonym.

*Rosa Demareei*, sp. nov.<sup>1</sup> Stems 6–12 dm. tall, reddish-brown and often glaucous or pruinose, usually hispid with straight, slender, broad-based spines 5–10 mm. long. Stipules narrow, adnate to the petioles, the free portions lanceolate and erect, those of the 1–3-foliate bracts subtending

<sup>1</sup> *Rosa Demareei*, sp. nov. Frutex erectus; caules 6–12 dm. alti, rubro-brunnescentes, saepe pruinosi, aculeis rectis tenuibus (5–10 mm. longis) basi dilatatis hispidi; ramuli graciles, infra stipulas armati. Stipulae petiolio adnatae, angustae, auriculis lanceolatis erectis, integræ vel glanduloso-serratae, eae foliorum infra flores latiores; folia 5–9, plerumque 7, obovata, apice rotundata, basi acuta, grosse-serrata, 5–25 mm. longa, 4–15 mm. lata, superne saturate viridia et leviter pilosa, subtus pallidiora et magis pubescens; petioli rachisque pubescens, armata. Flores solitarii vel raro 2–3 corymbosi, 4–5 cm. lati; petala obovata, rubicunda, apice emarginata; pedicelli glabri; hypanthium glabrum; sepala angusta, integra, caudato-appendiculata, 1.5–2 cm. longa, interne et ad marginem lanata, externe valde glanduloso-hispida; styli circiter 12–14. Fructus maturus non visus.

the flowers much broader; leaflets 5–9, usually 7, obovate, narrowed or cuneate at the base, rounded at the apex, 5–25 mm. long, 4–15 mm. broad, coarsely and simply serrate, thin but firm at maturity, bright green and sparsely pilose above, distinctly paler and more copiously pubescent beneath; petioles and rachis densely pubescent and usually armed with weak prickles. Flowers solitary or rarely two or three together, 4–5 cm. in diameter; petals obovate or obcordate, 1.5–2 cm. long, bright pink; pedicels and hypanthium glabrous; sepals narrowly lanceolate, dilated at apex, 1.5–2 cm. long, usually with entire margins, densely pubescent within and glandular-hispid on outer surface; styles about 12–14. Mature fruit not seen.

This distinct and handsome little Rose was found in several places in the higher parts of the Davis Mountains. In the Upper Limpia and Madera Canyons it was growing on moist banks and about springs. But it was most abundant on talus slopes below the high northwest-facing bluffs of Mt. Livermore at an altitude of about 2300 meters, where it was growing under the shade of the Trembling Aspen (*Populus tremuloides* var. *aurea*) and associated with other somewhat boreal plants.

The specific name is for Professor Delzie Demaree, who was with me when it was first seen. The type specimen is my number 34351, below high west-facing cliffs of Mt. Livermore, June 4, 1928. Other collections are number 30785, upper Limpia Canyon, June 11, 1926; 34385, same locality, June 6, 1928; and 34322, upper Madera Canyon, June 3, 1928.

Although the mature fruit is unknown this species, judging by the small number of the styles, appears to belong to the *Gymnocarpae* group, and it is probably most nearly related to *Rosa gymnocarpa* Nutt. However, it differs markedly from that species in its obovate, simply serrate leaflets with shorter petioles, in the character of the sepals, the enlarged-based spines, and especially in the broad stipules and modified bracts subtending the flowers. This last character appears to be quite constant and serves to distinguish our plant from related species.

*Prunus virens* (Wooton & Standley) Shreve. This handsome species of Wild Cherry is common in many places in the canyons and is most abundant at the higher altitudes. It becomes a tree with a maximum height of 14 or 15 meters. The fruit, which is sometimes borne in great profusion, is sweet and juicy and is eagerly eaten by bears and other wild animals.

*Prunus virginiana* var. *melanocarpa* (A. Nels.) Sarg. This variety of the Choke Cherry is a shrub usually less than 1.5 meters tall. It was seen only near the tops of the highest mountains, where it is a characteristic plant of the Summit Formation, growing on rocky slopes and talus under the high bluffs.

*Prunus virginiana* var. *pumicea* (Wooton & Standley), comb. nov. This variety grows in similar situations to the last, which it resembles in habit. It is *Padus pumicea* of Wooton & Standley.

**Prunus Murrayana**, sp. nov.<sup>1</sup> Shrub 1-2 meters tall, or probably becoming larger in protected situations, intricately branched or sometimes growing with erect stems and few ascending branches. Branchlets slender, rarely spiny, greenish-brown and densely pubescent the first season, becoming gray and glabrous or retaining some of the pubescence the second season. Stipules linear 6-10 mm. long, glandular-serrate. Leaves ovate to ovate-lanceolate, 3-5 cm. long, 1.5-2.5 cm. wide, rounded at the base, acute or acuminate at apex, finely and evenly serrate with shallow, obtuse teeth (12-14 to the cm.), thin but firm at maturity, scabrate above and pilose-pubescent beneath with short stiff hairs; petioles 5-10 mm. long, densely pubescent, eglandular. Flowers in simple 1-5-flowered umbels, on slender, 8-12 mm. long, densely pubescent pedicels, 8-12 mm. in diameter when fully expanded; petals obovate, short-clawed, 4-5 mm. long, exceeding the short stamens; calyx pubescent, the oblong-lanceolate lobes obtuse, glabrous within and densely hispid-pubescent on the outer surface. The mature fruit is unknown.

This plant, which was the only Wild Plum seen in the Davis Mountains region, was found growing on steep rocky banks of a stream, near the head of the Big Aguja Canyon. It was also found in a little dry canyon off the Limpia Canyon, near Ft. Davis. The plants at the first station were in flower, while those collected at the latter place show only the mature leaves.

Although I have not seen the fruit, this species is so distinct in the character of its inflorescence and in the pubescence from any of the other Plums with which I am acquainted that I venture to describe it as new. It is perhaps most closely related to *Prunus rivularis* Scheele, which it resembles in habit of growth, but from which it is well distinguished by the characters mentioned in the above description. My collection numbers are 33424, near head of Big Aguja Canyon, April 21, 1928 (type), and 34562, near Ft. Davis, June 13, 1928.

#### LEGUMINOSAE

*Acacia Wrightii* Benth. Plains and foot-hills and on the lower mountain slopes, mostly below 1700 meters. A shrub or rarely becoming a small tree in the Davis Mountains.

*Acacia constricta* Benth. This species is confined to the plains and foot-hills, where it becomes a small tree up to 6 or 7 meters tall.

*Acacia angustissima* (Mill.) Kuntze. Open rocky ground at the lower altitudes. Suffruticose or barely woody at the base.

<sup>1</sup> *Prunus Murrayana*, sp. nov. Frutex erectus, ut videtur 1-2 m. altus; rami ascendentes, intricati, nigrescentes, glabri; ramuli graciliores raro spinescentes, annotini viridi-brunnescentes, pubescentes, biennes vetustioresque cinerascentes, glabri vel leviter pubescentes. Stipulae lineares, glandulososerratae; folia ovato-lanceolata vel anguste ovata, basi rotunda, apice acuta vel acuminata, tenuiter serrata, matura papyracea, superne scabrida, subtus breviter pilosa; petioli 5-10 mm. longi, pubescentes, eglandulosi. Flores parvi, 8-12 mm. diam. in umbellis 1-5-floris; pedicelli graciles, 8-12 mm. longi, dense pubescentes; petala obovata, 4-5 mm. longa, apice rotundata, basi attenuatis, staminibus longiores; calyx campanulatus, pubescens; sepala ovato-oblonga, margine glandulososerrata, apice obtusa, interne glabra, externe hispido-pubescentes. Fructus ignotus.

*Acacia angustissima* var. *hirta* (Nutt.) Robinson. More common than the typical form and growing in similar situations.

*Leucaena retusa* Benth. Found only in the foot-hills and lower canyons. A small tree with showy yellow flowers.

*Mimosa biuncifera* Benth. Plains and foot-hills and in open canyons up to altitude of about 2000 meters. A very spiny shrub, and apparently the only species of Cat's-claw in the Davis Mountains.

*Prosopis juliflora* var. *velutina* (Wooton) Sarg. The Mesquite is usually shrubby, rarely becoming a small tree up to about 6 meters tall, as it grows in this region.

*Caesalpinia Gilliesii* (Hook.) Wall. Escaped from cultivation and thoroughly establishes in and about Ft. Davis. This showy flowering shrub, sometimes called Bird of Paradise, is a native of South America.

*Dalea formosa* (Gray) Vail. Dry rocky ground at the lower altitudes. A low shrub, seldom over 3 decimeters tall.

*Dalea frutescens* Gray. Rocky ground along streams and on slopes of low hills.

*Sophora secundiflora* (Cav.) DC. Rocky canyons and hillsides, plains and foot-hills.

*Krameria glandulosa* Rose. Rocky open ground at the lower altitudes.

#### ZYGOPHYLLACEAE

*Covillea tridentata* (Cav.) Vail. The Creosote Bush was seen only in the plains near the mouth of Little Aguja Canyon.

#### RUTACEAE

*Ptelea polyadenia* Greene. Often common along banks of canyons above an altitude of 1700 meters.

#### SIMAROUBACEAE

*Koeberlinia spinosa* Zucc. This remarkably spiny shrub, known as The Crown of Thorns, is found only in the plains and foot-hills, where it sometimes attains a height of 3 or 4 meters.

#### EUPHORBIACEAE

*Croton fruticulosus* Torr. A rather common shrub in rocky canyons and ravines of the plains and foot-hills.

*Croton suaveolens* Torr. Rocky open ground, foot-hills near Ft. Davis.

#### ANACARDIACEAE

*Rhus copallina* var. *lanceolata* Gray. Grows in canyons up to about 2000 meters. A tree-like shrub sometimes 3 to 4 meters tall.

*Rhus virens* Lindl. Found only at the lower altitudes, on plains and in canyons.

*Rhus trilobata* Nutt. A very common shrub in rocky ground from the plains almost to the highest levels.

*Rhus Rydbergii* Small. Moist banks in the lower canyons.

*Rhus microphylla* Engelm. A shrub found only on the plains and in the lower foot-hills and canyons.

#### CELASTRACEAE

*Celastrus scandens* L. This widely distributed species of Bittersweet was seen in the Madera Canyon and in a short canyon a little to the east of Mt. Livermore.

#### ACERACEAE

*Acer grandidentatum* var. *brachypterum* (Wooton & Standley), comb. nov. The Maple appears to be confined to the lower canyons in the Davis Mountains. It is a shrub or small tree with crooked stems and branches. The foliage and fruit are quite variable and although in extreme forms it looks quite distinct it probably cannot be kept separate by any constant good characters from *A. grandidentatum*, and it is perhaps best to consider *A. brachypterum* Wooton & Standley, as a variety of that species.

#### SAPINDACEAE

*Sapindus Drummondii* Hook. & Arn. The Soap-berry or Wild China is a small tree found in the lower canyons and up to altitudes of about 1800 meters.

*Ungnadia speciosa* Endl. This tall shrub, called Mexican or Spanish Buckey, grows along rocky streams and bluffs in the lower canyons.

#### RHAMNACEAE

*Rhamnus Purshiana* DC. This species grows in the upper canyons from about 1700 to the highest altitudes. It is a shrub 2-3 meters tall. The drug Cascara Sagrada is obtained from the bark.

*Rhamnus fasciculata* Greene. A species found only in the higher canyons and along bluffs near the tops of the mountains from about 2000 meters to the highest altitudes. This is a shrub 2-3 meters tall. It differs somewhat in the shape of the leaves and in the character of the pubescence from Greene's description and from plants collected in New Mexico, and I was at first inclined to regard it as a distinct species. But the differences do not appear to be constant or important enough to distinguish it from this species.

*Condalia obovata* Hook. This is a common shrub in the plains and foot-hills, but it is not found at the higher levels.

*Microrhamnus ericoides* Gray. A low, very spiny shrub growing in rocky ground in the plains and foot-hills.

*Ceanothus Fendleri* Gray. Grows along streams and in rocky open ground in the canyons at elevations between 1900 and 2100 meters. It is a spiny shrub about a meter tall, with heads of pinkish blossoms.

*Adolphia infesta* Meisn. This is a low, spreading, spiny shrub, often very common on dry slopes from altitudes of 1700 to 2100 meters.

## VITACEAE

*Vitis arizonica* Engelm. This is the only species of Grape seen in the region, and there is considerable variation in the shape of the leaves in different plants. It is often common in the canyons, especially at the higher altitudes. The fruit is small but sweet and it is greedily eaten by the bears.

*Parthenocissus vitacea* Hitchc. This species of the Virginia Creeper was seen only at the higher elevations where it grows in deep rocky canyons and under bluffs.

*Parthenocissus quinquefolia* (L.) Planch. This species is apparently less common than the last, and grows in similar situation and perhaps at lower levels. It was seen on Sawtooth Mountain and in the Little Aguja canyon.

*Cissus incisa* var. *Andrewsii*, var. nov.<sup>1</sup> In this variety the leaves differ from the typical form in being usually if not always simple or one-foliate, broadly ovate in outline, 3-8 cm. long and about as broad, usually deeply three-lobed and the lobes coarsely toothed with obtuse apiculate pointed teeth, and open-cordate at the base. The inflorescence is umbellate and apparently somewhat smaller than in the typical form. Further study and better material may prove this to be a distinct species, but for the present it is perhaps best to treat it as a variety.

The plant was seen growing in a dry rocky ravine off the Limpia Canyon, near Ft. Davis and in the Little Aguja Canyon. The specimen which I am taking as the type was collected by *D. M. Andrews*, no. 17, Ft. Davis, Aug. 21, 1913. Other collections referred to this variety are *D. M. Andrews*, no. 41, Ft. Davis, Aug. 23, 1913; *Geo. L. Fischer*, no. 82, Devil's River, Texas, July 14, 1927; *E. J. Palmer*, no. 34475, Ft. Davis, June 11, 1928, and no. 34517, Little Aguja Canyon, June 12, 1928, all in the herbarium of the Arnold Arboretum; and *F. Lindheimer*, nos. 497 and 719, New Braunfels, Texas, Aug., 1850, in the Gray Herbarium.

## MALVACEAE

*Abutilon lignosum* (Cav.) Don. This is a frutescent shrub about one meter tall, found growing in dry rocky ravines and canyons near Ft. Davis.

## CACTACEAE

*Opuntia imbricata* (Haw.) DC. Very common on rocky plains and foot-hills and up to altitudes of about 1800 meters. Grows as a stout shrub sometimes 2 to 3 meters in height.

*Opuntia Kleiniae* DC. Grows in rocky plains and in open canyons at the lower altitudes.

*Opuntia leptocaulis* DC. Found in similar situations to the last but nowhere common.

<sup>1</sup> *Cissus incisa* var. *Andrewsii*, var. nov. A typo recedit foliis simplicibus plerumque profunde-trilobatis basi cordatis grosse dentatis.

*Opuntia polyacantha* Haw. Often common in rocky open ground, especially at the higher altitudes.

*Opuntia strigil* Engelm. Amongst rocks, upper part of Limpia Canyon.

*Opuntia Engelmannii* Salm. A common species in dry rocky open ground, especially at the lower levels.

*Opuntia macrocentra*? Engelm. What appears to be this species was collected near Ft. Davis. There are probably several other species of *Opuntia* growing in the region that were not collected or identified.

*Echinocactus horizonthalonius* Engelm. Dry plains near Ft. Davis and doubtless elsewhere in the region.

*Ferocactus hamatocanthus* (Muhlenpfordt) Rose. Shelves and crevices of rocks in the upper canyons and higher mountains.

*Echinomastus intertextus* (Engelm.) Britton & Rose. Amongst rocks; often common on the higher mountains.

*Echinocereus viridiflorus* Engelm. A common species amongst rocks at the higher altitudes.

*Echinocereus Rosei* Wooton & Standley. Ledges and crevices of rocks. Often common at the higher altitudes and very showy when in bloom, with a profusion of scarlet flowers.

*Echinocereus Reichenbachii* (Terscheck) Haage. Rocky open ground in the mountains.

*Echinocereus polyacanthus* Engelm. In crevices of rocks in the mountains.

*Echinocereus dubius* Engelm. Amongst rocks in the lower canyons, near Ft. Davis.

*Neomammillaria Pottsii* (Scheer) Britton & Rose. Along rocky ledges, especially at the higher altitudes.

The list of *Cacti* is probably far from complete, as I did not have facilities for collecting many species that were seen on the different trips.

#### ERICACEAE

*Arbutus texana* Buckley. This interesting tree, known in the region by the Mexican name of Madroña, is found in the canyons from the lowest levels up to about 2000 meters. It is sometimes shrubby but maximum specimens attain a height of 8 or 10 meters.

#### OLEACEAE

*Fraxinus texensis* (Gray) Sarg. This is the commonest species of Ash in the Davis Mountains, and it is found in watered canyons from the foot-hills up to an altitude of about 2200 meters. It is a small tree with a maximum height of about 10 meters.

*Fraxinus velutina* Torr. This species also grows in the watered canyons but it was not noticed at the lower levels.

*Fraxinus velutina* var. *glabra* Rehder. The glabrous form of this species is found growing with the typical one, and is apparently about as common.

*Forestiera pubescens* Nutt. This shrub grows on rocky banks in the canyons and is rather frequent, especially at the higher altitudes.

*Forestiera neo-mexicana* Gray. This species grows in similar situations to the last and is perhaps commoner at the lower levels.

*Menodora hispida*, sp. nov.<sup>1</sup> A low frutescent plant, about 3 decimeters tall, from a stout woody base. Leaves small, narrowly oblong, 5–10 mm. long, 2–4 mm. wide, strongly revolute, firm and subcoriaceous, punctate, with sparse but harsh hispid pubescence, scabrate above. Calyx campanulate, deeply cleft into about 9 linear lobes, 12–15 mm. long, ciliate and exceeding the capsule. Capsules about 1 cm. high. Flowers not seen.

Collected in dry rocky ground, just above Limpia Canyon, near Ft. Davis. Type specimen is my number 32112, Oct. 8, 1926.

*Menodora longiflora* Gray. This is a slender shrub sometimes 6 dm. tall. It is found in dry rocky ground in the foot-hills and lower parts of the canyons.

#### LOGANIACEAE

*Buddleia scordioides* H.B.K. A low shrub found on rocky slopes and ledges at the lower altitudes.

#### APOCYNACEAE

*Macrosiphonia brachysiphon* (Torr.) Gray. This is a small shrub about 2 or 3 dm. tall, with showy white flowers. It grows in rocky ground at the lower altitudes.

#### ASCLEPIADACEAE

*Metastelma plumosa* Small & Alexander. A slender woody vine, often common on dry rocky ledges at lower and middle altitudes.

*Philiberta crispa* Hemsl. A slender vine with woody base and somewhat woody stems. Found along rocky streams in the canyons.

#### POLEMONIACEAE

*Phlox Stansburyi* (Torr.) Heller. A slender plant with woody stems and a stout ligneous base. It was collected in the foot-hills near Ft. Davis.

#### VERBENACEAE

*Lippia ligustrina* (Lag.) Britton. This species is a tall shrub up to 3 or 4 meters in height. It is found in the moister situations in the canyons mostly at the lower levels. The small white spicate flowers are very fragrant and furnish a valuable bee food. The foliage is also eaten by stock.

*Lippia Wrightii* Gray. A low spreading shrub, found on rocky ledges, mostly at the higher altitudes.

<sup>1</sup> *Menodora hispida*, sp. nov. Frutex parvus vel suffrutex erectus, ad 3 dm. altus; rami graciles, striato-angulati, hispidi. Folia satis crasse chartacea, angusto-oblonga, apice apiculata, 5–10 mm. longa, 3–4 mm. lata, revoluta, hispido-pubescentia, supra scabrida. Calyx campanulatus, profunde incisus, lobis plerumque 9 linearibus ciliatis 12–15 mm. longis. Capsulae circiter 1 cm. longae. Flores non visae.

## BIGNONIACEAE

*Chilopsis linearis* (Cav.) Sweet. The Desert Willow grows along the rocky flood-plains of streams and is often common at the lower levels and up to about 1800 meters altitude.

*Tecoma stans* var. *angustifolia* Rehder. This beautiful shrub is often abundant on rocky banks in the foot-hills and lower canyons. The profusion of large trumpet-like yellow blossoms make it very conspicuous during the long flowering season.

## RUBIACEAE

*Bouvardia triphylla* Salisb. A very showy little shrub with a profusion of scarlet blossoms. It grows on dry rocky ledges at all altitudes.

## CAPRIFOLIACEAE

*Lonicera albiflora* var. *dumosa* (Gray) Rehder. This bushy Honeysuckle is often common on rocky banks of the canyons, especially at the higher altitudes.

*Syphoricarpos oreophilus* Gray. Found only at the higher altitudes above approximately 2100 meters, where it grows on banks and rubble. The rather large pinkish flowers are borne in great profusion and are followed by an abundance of white berries. The plant trails or inclines over banks and grows in great luxuriance in certain favorable localities.

*Sambucus coerulea* Raf. This species of Elderberry is very restricted in its occurrence in the Davis Mountains, being found only at a few places at the highest altitudes, where it is a characteristic plant of the Summit Formation. Under the high cliffs on the north side of Mt. Livermore it sometimes is quite tree-like, attaining a height of 4-5 meters and having stems 12-14 cm. in diameter. There is considerable variation in the leaves, one form with narrow deeply incised leaflets appearing rather distinct.

*Sambucus coerulea* var. *arizonica* Sarg. This variety, in which the leaflets are broader and usually only three to five in number, was seen only in cultivation in yards at Ft. Davis, where it becomes a small tree. The plants had been brought in from somewhere in the mountains, and it should be looked for at the higher altitudes.

## COMPOSITAE

*Eupatorium ageratifolium* DC. A low shrub found in rocky ground in the lower canyons.

*Carpochaete Bigelovii* Gray. On rocky banks and walls of canyons, and common at altitudes of 1700 to 2000 meters.

*Brickellia Wrightii* Gray. Grows on rocky banks and slopes in the lower canyons and foot-hills.

*Brickellia baccharidea* Gray. This species grows on rocky bluffs and banks and is found up to 2000 or 2100 meters altitude.

*Brickellia lacinata* Gray. On dry rocky slopes and ledges in the canyons and on mountain slopes.

*Brickellia californica* Torr. & Gray. This species was found in rocky ground in the foot-hills.

*Flourensia cernua* D.C. This shrub, usually called Tar-bush, was seen in the Davis Mountains region only on sterile plains near the mouth of Little Aguja Canyon.

*Gymnosperma corymbosa* DC. Common in rocky open ground, in the canyons and on mountain slopes, especially at the lower altitudes.

*Baccharis Wrightii* Gray. A low shrub growing in rocky ground in the canyons and foot-hills.

*Baccharis texana* Gray. Along rocky streams in the canyons, at the lower altitudes.

*Baccharis Bigelovii* Gray. Rocky banks and canyon walls.

*Baccharis californica* Torr. & Gray. Foot-hills and lower canyons.

*Trixis angustifolia* DC. Foot-hills and lower canyons.

*Trixis californica* Kellogg. In rocky ground, foot-hills, near Ft. Davis.

*Laphamia rupestris* Gray. Often common in clefts and crevices of rocks and along cliffs, at all altitudes.

*Artemisia filifolia* Torr. Rocky flood plains of streams, lower canyons.

*Senecio filifolius* Nutt. Dry rocky ground, foot-hills, plains and mountain slopes, except at the highest altitudes.

*Senecio Riddellii* Torr. & Gray. Grows in similar situations to the last species, and often very common.

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## PROPOSED AMENDMENTS TO THE INTERNATIONAL RULES OF BOTANICAL NOMENCLATURE

ALFRED REHDER

Since the publication of the International rules of botanical nomenclature adopted by the International Botanical Congress at Vienna in 1905 I have tried to follow them and the amendments adopted by the Congress held in 1910 in Brussels, but in several instances the rules seemed to allow of different interpretations, while in others the results of their strict application did not seem altogether satisfactory and conducive to the greatest possible stability in nomenclature. I have already in two articles<sup>1</sup> pointed out some of the doubtful cases and suggested modifications and now I wish to present in more definite form certain amendments which I consider desirable. In these propositions no changes of principles are involved, they only consist of extensions or modifications of the adopted rules, some caused by the application of the type method and some by a clearer distinction between taxonomic and nomenclatural validity.

### ARTICLE 12

Art. 12. Finally if circumstances require us to distinguish a greater number of intermediate groups, it is easy, by putting the syllable *sub* before the name of a group, to form subdivisions of that group. In this way subfamily (*subfamilia*) designates a group between a family and a tribe, subtribe (*subtribus*) a group between a tribe and a genus, etc. The arrangement of subordinate groups may thus be carried, for wild plants only, to twenty-two degrees, in the following order: Regnum vegetable. Divisio. Subdiviso. Classis. Subclassis. Ordo. Subordo. Familia. Subfamilia. Tribus. Subtribus. Genus. Subgenus. Sectio. Subsectio. Species. Subspecies. Varietas. Subvarietas. Forma. Forma Specialis. Individuum.

If this list of groups is insufficient it can be augmented by the intercalation of supplementary groups, so long as these do not introduce confusion or error.

Example: *Series* and *Subseries* are groups which can be intercalated between subsection and species.

### PROPOSED CHANGE

Art. 12. Finally if circumstances require us to distinguish a greater number of intermediate groups, it is easy by putting the syllable *sub* before the name of a group to form subdivisions of that group: in this way subfamily (*subfamilia*) designates a group between a family and a tribe, subtribe (*subtribus*) a group between a tribe and genus, etc. The arrangement of subordinate groups may thus be carried to twenty-five degrees in the following order: Regnum vegetable. Divisio. Subdivisio. Classis. Subclassis. Ordo. Sub-

<sup>1</sup> Jour. Arnold Arb. I. 44 (1919) and VIII. 58 (1927); also in Jour. Bot. LIX. 289 (1921).

ordo. Familia. Subfamilia. Tribus. Subtribus. Genus. Subgenus. Sectio. Subsectio. Series. Subseries. Species. Subspecies. Varietas. Subvarietas. Forma. Forma specialis. Lusus. Individuum.

If this list of groups is insufficient it can be augmented by the intercalation of supplementary groups, so long as these do not introduce confusion or error.

Example: *Grex* which can be intercalated between subgenus and sectio; *proles* (or *stirps*) which can be intercalated between subspecies and varietas; *clon* between forma and individuum.

#### ARTICLE 20

Art. 20. However, to avoid disadvantageous changes in the nomenclature of genera by the strict application of the rules of nomenclature, and especially of the principle of priority in starting from the dates given in art. 19, the rules provide a list of names which must be retained in all cases. These names are by preference those which have come into general use in the fifty years following their publication, or which have been used in monographs and important floristic works up to the year 1890.

#### ADD AFTER THE FIRST PARAGRAPH:

Similarly, to avoid changes in the names of well known species which would be displaced by the strict application of the principle of priority or which have been variously interpreted because they include different elements without clear indication of the typical form or because their original description contains some erroneous statement, a list of binomials is provided with indication on which part of the original description or synonymy the name should be based or in which restricted sense it should be used. The list of these names forms an appendix to the Rules of Nomenclature.

#### RECOMMENDATION VI

##### ADD TO THIS RECOMMENDATION:

###### VI.

d) Avoid in coördinated subdivisions of a genus the use of names in the form of a noun together with those in the form of a plural adjective; the former should be used chiefly for subgenera, sections and subsections, the latter for series and subseries.

#### ARTICLE 28

Art. 28. Names of subspecies and varieties are formed like specific names and follow them in order, beginning with those of the highest rank. The same holds for subvarieties, forms, and slight or transient modifications of wild plants which receive a name or numbers or letters to facilitate their arrangement. Use of a binary nomenclature for subdivisions of species is not admissible.

#### PROPOSED CHANGE

Art. 28. Names of subspecies and varieties are formed like specific names and follow them in order, beginning with those of the highest grade. The same holds for subvarieties, forms, and slight or transient modifications which receive a name or numbers or letters to facilitate their arrangement. Use of binary nomenclature for subdivisions of species is not admissible.

All subdivisions of a species are of the same nomenclatural rank, the subordinate groups being considered different grades of the same rank.

#### ARTICLE 29

Art. 29. Two subspecies of the same species cannot have the same name. A given name can only be used once for a variety of a given species, even when dealing with varieties which are classed under different subspecies. The same holds for subvarieties and forms.

On the other hand the same name may be employed for subdivisions of different species, and the subdivisions of any one species may bear the same name as other species.

#### PROPOSED CHANGE

Art. 29. Two subspecies of the same species cannot have the same name, a given name can only be used once for a variety of a given species even when dealing with varieties which are classed under different subspecies. The same holds for subvarieties and forms; in short, the same name can be used only once for a subdivision of a given species except when the name is used for a subordinate subdivision based on the same type.

On the other hand the same name may be employed for subdivisions of different species and the subdivision of any one species may bear the same name as other species.

Additional examples:—*Andropogon Sorghum* subsp. *halepensis* var. *halepensis* Hackel,—two subdivisions bearing the same name, but representing subordinate grades based on the same type, namely on *A. halepensis* Brot. and being thus synonymous except that the name of the lower subdivision is used in a restricted sense.

#### RECOMMENDATION XV

AFTER RECOMMENDATION XV<sup>bis</sup> ADD:

XV<sup>ter</sup> Avoid giving to the typical variety of a subspecies or the typical form of a variety, in short to the type of any subdivision of a species a new name. Use the same name or a customary title like *typicus*, *genuinus*, *originarius*. Examples: *Andropogon caricosus* subsp. *mollissimus* var. *mollissimus* Hackel; *Arthraxon ciliaris* Beauv. subsp. *Langsdorffii* var. *genuinus* Hackel.

### ARTICLE 31

#### ADD AS A FOURTH PARAGRAPH:

Asexual hybrids (graft-hybrids, chimeras, etc.) are treated like the sexual hybrids; they receive, even if between the same species as a sexual hybrid, a different specific epithet with the sign + before the name and in the formula the parent species are connected by the sign +.

### ARTICLE 32

Art. 32. Intergeneric hybrids (between species of different genera) or presumably such, are also designated by a formula, and, when it seems useful or necessary, by a name.

The formula consists of the names of the two parents, in alphabetical order.

The hybrid is associated with the one of the two genera which precedes the other in alphabetical order. The name is preceded by the sign ×.

#### PROPOSED CHANGE

Art. 32. Intergeneric hybrids (between species of different genera) or presumably such, are also designated by a formula, and, when it seems useful or necessary, by a name.

The formula consists of the names of the two parents, in alphabetical order.

The name consists of a new generic name usually formed by a combination of the names of the parent genera, and a specific epithet.

Asexual hybrids between two genera are classed under the same generic name as the sexual hybrids, but a graft-hybrid between the same species as a sexual hybrid is distinguished by a different specific epithet and in the formula the names of the two parent species are connected by the sign +.

Examples: *Odontioda Boltonii* = *Cochlioda Noezliana* × *Odontoglossum Vuylstekeae*.—*Pyronia* (*Cydonia* × *Pyrus*) with a sexual and an asexual hybrid: × *P. Veitchii Guillaum.* = *Cydonia oblonga* × *Pyrus communis*, and + *P. Danielii* (Hans Winkl.) Rehd. = *Cydonia oblonga* + *Pyrus communis*.

### ARTICLE 34

Art. 34. When there is reason to distinguish the different forms of a hybrid (pleomorphic hybrids, combinations between different forms of collective species, etc.) the subdivisions are classed under the hybrid like the subdivisions of species under a species.

#### PROPOSED CHANGE

Art. 34. When there is reason to distinguish the different forms of a hybrid (pleomorphic hybrids, combinations between different forms of collective species, etc.) the subdivisions are classed under the binomial of the hybrid like the subdivisions of a species under a species.

## ARTICLE 42

## ADD AS A SECOND PARAGRAPH

If desirable or necessary to abbreviate these citations the name of the publishing author as the more important must be retained.

Additional examples: "*Gesnera Donklarii* Hort. apud Hook. may be shortened to *Gesnera Donklarii* Hook."

## RECOMMENDATION XXV

ADD AFTER RECOMMENDATION XXV<sup>ter</sup>

XXV<sup>quat</sup>. In citing a name published as a synonym the words "as a synonym" or "pro synon." should be added to the citation. If it is a manuscript name the word "ex" should preferably be used to connect the names of the original author and the author publishing it as a synonym and "apud" if the name published is a valid name. The preposition "in" should be reserved for such cases when the publishing author publishes a description contributed by the author of the name. (*Myrtus serratus* Koenig ex Steudel, Nomencl. 321 (1821), an unpublished name cited as a synonym of *Eugenia laurina* Willd. by Steudel, Nomencl. 321 [1821]; *Stewartia koreana* Nakai apud Rehder, a manuscript name of Nakai's published with a description by Rehder in Jour. Arnold Arb. IX. 31 [1828]; *Viburnum ternatum* Rehder in Sargent, a species described by Rehder and the description published by Sargent, Trees & Shrubs, II. 37, t. 117 [1907]).

## ARTICLE 45

When a genus is divided into two or more genera, the name must be kept and given to one of the principal divisions. If the genus contains a section or some other division which, judging by its name or its species, is the type or the origin of the group, the name is reserved for that part of it. If there is no such section or subdivision, but one of the parts detached contains a great many more species than the others, the name is reserved for that part of it.

## PROPOSED CHANGE

Art. 45. When a genus is divided into two or more genera the name must be kept and given to the division containing the species which is either designated as the type or is evidently the type of the genus. If there is no such species, the author who effects the first division chooses and his choice cannot be modified provided that the part to which he gives the name contains one or more of the species upon which the genus was originally based.

In cases where opinions differ as to the correct interpretation of this rule or where the strict application would result in the change of the name of an important genus, the name should be placed on the list of *Nomina generica conservanda* with the indication which

species is to be considered the type or standard species of the genus.

#### ARTICLE 47

**Art. 47.** When a species or subdivision of a species is divided into two or more groups of the same nature, if one of the two forms was distinguished or described earlier than the other, the name is retained for that form.

Examples: *Genista horrida* DC. Fl. Franc. IV. 500 was divided by Spach (in Ann. Sci. Nat. ser. 3, II., 253 [1844] into three species: *G. horrida* DC., *G. Boissieri* Spach and *G. Webbii* Spach; the name *G. horrida* was rightly kept for the earliest described form, that described and figured by Vahl and Gilibert.—Several species (*Primula cashmiriana* Munro, *P. erosa* Wall.) have been separated from *Primula denticulata* Sm. (Exot. Bot. II, 109, tab. 114), but the name *P. denticulata* has been rightly kept for the form which Smith described and figured under this name.

#### PROPOSED CHANGE

**Art. 47.** When a species or subdivision of a species is divided into two or more groups of the same nature, the name is retained for that group to which the type or the type specimen belongs.

Example: *Genista horrida* DC., Fl. Franc. IV. 500 was divided by Spach into three species: *G. horrida* DC., *G. Boissieri* Spach and *G. Webbii* Spach; the name *G. horrida* was rightly kept for the form based on *Spartium horridum* Vahl.—*Philadelphus subcanus* Koehne was separated in 1904 (in Mitt. Deutsch. Dendr. Ges. XIII. 83) from *P. incanus* Koehne (in Gartenfl. XLV. 562, 1896), but the name was rightly kept for the majority of specimens cited upon which the description was based and which must be considered as representing the type of *P. incanus*.

#### ARTICLE 48

**Art. 48.** When a subgenus or section or species is moved into another genus, when a variety or other division of a species is moved into another species, retaining there the same rank, the original name of the subgenus or section, the first specific epithet, or the original name of the division of the species must be retained or must be re-established, unless, in the new position there exists one of the obstacles indicated in the articles of section 7.

#### PROPOSED CHANGE

**Art. 48.** When a subdivision of a genus or a species is moved into another genus, or when a subdivision of a species is moved into another species, the original name of the subdivision of the genus, the first specific epithet, or the original name of the subdivision of the species must be retained or must be re-established, unless in the new position there exists one of the obstacles indicated in the articles of section 7.

The name of a species or of a subdivision of a species applied, when transferred to another genus or species, erroneously in its new position to a different plant, stands for the plant upon which it was originally based.

Additional example: Var. *macrobotrys* Lavallé, Arb. Segrez. 65 (1871) of *Wistaria sinensis* when transferred as a forma to *W. floribunda* retains its name *W. floribunda* f. *macrobotrys* Rehd. & Wils. in Sargent, Pl. Wilson. II. 513 (1916).—*Tsuga Mertensiana* whose specific epithet was taken by Carrière from *Pinus Mertensiana* Bong. and published with a description of another *Tsuga*, namely *T. heterophylla* (Raf.) Sarg., must be maintained as the correct name of the tree described by Bongard which was called *T. Hookeriana* by Carrière. To avoid any possible doubt of the meaning of the name, it should be quoted as *T. Mertensiana* Carr. sensu Sarg. or *T. Mertensiana* Sarg., while *T. Mertensiana* Carr. (quoad descriptionem) becomes a synonym of *T. heterophylla* Sarg.

#### ARTICLE 50

Art. 50. No one is authorized to reject, change or modify a name (or combination of names) because it is badly chosen, or disagreeable, or another is preferable or better known, or because of the existence of an earlier homonym which is universally regarded as non-valid, or for any other motive either contestable or of little import. (See also art. 57.)

#### PROPOSED CHANGE

Art. 50. No one is authorized to reject, change or modify a name (or combination of names) because it is badly chosen or disagreeable, or another is preferable or better known, or because of the existence of an earlier homonym which is non-valid, or for any other motive either contestable or of little import. (See also art. 56 and 57.)

#### ARTICLE 51

Art. 51. Everyone should refuse to admit a name in the following cases:

3. When it is based on a monstrosity.
4. When the group which it designates embraces elements altogether incoherent, or when it becomes a permanent source of confusion or error.

#### PROPOSED CHANGE

Art. 51. Everyone should refuse to admit a name in the following cases:

3. When it is the name of a species placed in a genus which has no affinity whatever to the genus to which the species actually belongs.

4. When the group which it designates embraces elements altogether incoherent or when it becomes a permanent source of confusion or error. A list of names to be abandoned for these reasons is appended to the Rules of Nomenclature (*Nomina specifica rejicienda*).

#### ARTICLE 53

Art. 53. When a subgenus, a section or a subsection, passes as such into another genus, the name must be changed if there is already, in that genus, a valid group of the same rank, under the same name.

When a species is moved from one genus into another, its specific epithet must be changed if it is already borne by a valid species of that genus. Similarly when a subspecies, a variety, or some other subdivision of a species is placed under another species, its name must be changed if borne already by a valid form of like rank in that species.

#### PROPOSED CHANGE

Art. 53. When a subdivision of a genus passes into another genus, when a species is moved from one genus into another or when a subdivision of a species is placed under another species, its name must be changed, if there exists already a valid homonym in the new position.

#### ARTICLE 55

Art. 55. Specific names must also be rejected in the following special cases:

#### ADD TO THIS ARTICLE

3°. When they occur in a work in which binomial nomenclature is not recognized.

Add to the Examples: 3°. *Alnus vulgaris* Hill, Brit. Herbal, 510 (1756) was not proposed as a binomial, as it occurs in a work in which binomial nomenclature was not adopted.

#### ARTICLE 58

Art. 58. The rules of botanical nomenclature can only be modified by competent persons at an International Congress convened for the express purpose.

#### PROPOSED ADDITION

The permanent Committee on Nomenclature shall have the power to render in doubtful cases binding decisions regarding interpretations of the Rules of Nomenclature; it also shall have the power of adding new names to the list of *Nomina conservanda* and of *Nomina rejicienda*. The findings and decisions of the Committee will be published regularly in a botanical periodical. The Committee may have the power to fill seats which have become vacant and if considered necessary, to add new members to its body.

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#### EXPLANATIONS AND REMARKS TO THE AMENDMENTS PROPOSED ABOVE

#### ARTICLE 12

It seems desirable to augment the enumeration of subordinate groups by such frequently used terms as series and subseries for groups to be intercalated between *subsectio* and *species* and *lusus* for a group between *forma* and *individuum*. The term *series* has been quite generally employed in this sense, though occasionally it has been used in a different sense, e. g. by

Pax & Hoffmann who apply this term to groups between subtribus and genus (see Engler, Pflanzenr. IV. 147<sup>IV</sup>. 10). As all plants wild and cultivated are objects of botanical classification, there seems to be no need to restrict the arrangement of subordinate groups to wild plants and the words "for wild plants only" may be as well omitted. If in special cases an additional group for cultivated plants should be needed, the second paragraph of art. 12 permits the intercalation of supplementary groups.

The term *grex* may serve as the name for a group to be intercalated between subgenus and sectio as done by Koehne (in Engler, Pflanzenr. IV. 216; see p. 83), though Pax and Irmscher (see Engler, Pflanzenr. IV. 117<sup>1</sup>, 6), use it instead of *series*, but as we have *series* as the customary term for this group, *grex* is better used in Koehne's sense. For a group between subspecies and varietas *proles* may be used as done by Rouy (Fl. de France, see X. 3), and *clon* (Greek κλων, twig, shoot)<sup>1</sup> for a group between forma and individuum. Another term is needed for a group between subtribe and genus for which perhaps *cohors* or *turma* could be employed.

#### ARTICLE 20

The preservation of the names of certain well known, economically and horticulturally important species, names which by strict application of the rules of nomenclature would be changed, is as important as the preservation of well known generic names and in fact even more so than that of many of these names which scarcely figure in the literature of applied botany and whose removal from the list of conserved names would hardly be felt outside of strictly taxonomic literature, while the transfer to other species of such names like *Quercus rubra* and *Populus balsamifera* which have stood for more than 150 years for plants treated in innumerable botanical, forestal, horticultural and other economic publications is causing much confusion and great inconvenience to workers in many fields. For these reasons it seems advisable to have a list compiled and published of important and well known names which should be preserved in the sense in which they have been used extensively over a long period, in some cases for more than 150 years, or which have been interpreted differently by different botanists and should be tied down to a definite type. The fixation, even if more or less arbitrary, of names of varying interpretation, will be of great advantage. Much time and energy will be saved, if one is not forced every time one has to use a doubtful name which one has not yet carefully examined to study its history and synonymy in order to find out which of the divergent opinions should be considered correct.

Such names are for instance the following:—

*Quercus rubra* Linnaeus (Spec. pl. II. 996. 1753) should be based on the citation "Quercus foliorum sinibus obtusis . . . Hort. Cliff. 448" and applied in the sense of Du Roi (Observ. Bot. 35. 1771), Michaux (Hist.

<sup>1</sup>See Webber in Science, n. s., XVIII. 501-503 (1903) and Stout in Jour. N. Y. Bot. Gard. XXX. 35 (1929).

Chênes Am. no. 20, t. 35, 36. 1801) and Sargent (Silva N. Am. VIII. 125, t. 409, 410. 1895). Syn.: *Quercus borealis* var. *maxima* Ashe.—The name *Quercus rubra* has stood for more than 150 years for the well known American Red Oak, one of the most important species of the American Oaks and extensively planted in this country and in Europe. It was not until 1915 that attention was drawn to the fact by C. S. Sargent (in *Rhodora*, XVII. 39) that the literature cited in the first place by Linnaeus and serving as the base for his description refers to the species later described by Michaux as *Q. falcata*, and the name *Q. rubra* was therefore transferred to that species, while the *Q. rubra* of Duroi and of all later authors became *Q. borealis* Michx. or *Q. borealis* var. *maxima* (Marsh.) Ashe. Considering the fact that the name *Q. rubra* was based at least partly on the common Red Oak, it seems permissible and even advisable to declare this citation the type of his species and conserve the name for the well known "Red Oak." Another alternative would be to consider the name as becoming a permanent source of confusion and to abandon it altogether in accordance with art. 51, 4. and to use instead *Q. falcata* Michx. for the first part and *Q. borealis* Michx. for the second part of Linnaeus' citations.

*Populus balsamifera* Linnaeus (Spec. Pl. II. 1034. 1753) should be based on the citation "Populus foliis cordatis crenatis basi nudis petiolis teretibus Wach. ultr. 294" and applied in the sense of Duroi (Harbk. Baumz. II. 143. 1772), Michaux (Hist. Arb. Am. III. 306, t. 13, fig. 1. 1813) and Sargent (Silva N. Am. IX. 167, t. 490. 1896). Syn.: *P. tacamahaca* Mill.—This case is very similar to the preceding, the name *P. balsamifera* having been used for more than 150 years for the Balsam Poplar, i. e. in the sense indicated above; it was not until 1919 when Farwell (in *Rhodora*, XXI. 101) drew attention to the fact that the type of the species should be the plant known as *P. deltoidea* Marsh. and transferred the name to that species. If abandoned as a source of confusion, it would be replaced by *P. tacamahaca* Mill. and *P. deltoidea* Marsh.

*Prunus virginiana* Linnaeus (Spec. Pl. I. 473. 1753) quoad specimen in Herb. Linn. et exclud. synon. omnibus; sensu Willdenow, Berlin. Baumz. 238, t. 5, fig. 1 (1796) et Spec. Pl. II. pt. II. 985 (1799), Sargent, Silv. N. Am. IV. 41, t. 158 (1892). Syn.: *P. nana* Duroi, Harbk. Baumz. II. 194, t. 4 (1772). This has been the prevailing interpretation of the name since about the middle of last century and a shifting of this name to the Black Cherry (*P. serotina* Ehrh.) to which most of the synonyms cited by Linnaeus belong would cause much confusion, since both species are economically important (see Fernald in *Rhodora*, XVIII. 141 [1916], also MacKenzie in *Rhodora*, XXX. 234 [1929]).

*Azalea calendulacea* Michaux (Fl. Bor. Am. I. 151. 1803) should be based on his var.  $\beta$ . *crocea* (l. c.) and applied in the sense of Rehder (in Wilson & Rehder Monog. Azaleas, 127. 1921).—Michaux's description of the species was based chiefly on the plant called by him var. *β. crocea* and not on his var.  $\alpha$ . *flammea* which is identical with *Rhododendron speciosum*;

also the specific name shows that he intended the name for the generally orange-colored var. *crocea* and not for the scarlet var. *flammea*. If in this case var.  $\alpha$  should be considered the type of the species, as it is customary, the name would have to be transferred from the plant for which it has stood for more than 100 years to the rare and little known *R. speciosum* (Willd.) Sweet.

*Magnolia denudata* Desrousseaux (in Lamarck Encycl. Meth. Bot. III. 675 [1791]) should be based on *Mokkwuren fl. albo* Kaempfer Amoen. v. 845 (1912) and on *Mokkwuren* I. of Banks Icon. Kaempfer t. 43 (excl. descript.) (1791) and applied in the sense of Rehder & Wilson (in Sargent, Pl. Wilson. I. 399. [1913]). Synon.: *M. conspicua* Salisb., *M. Yulan* Desf. —In 1905 Schneider (Ill. Handb. Laubholz k. 330) had taken up *M. denudata* Desrouss. as the oldest name for *M. purpurea* Curtis relying apparently chiefly on the color of the flower as given in Desrousseaux's description who had erroneously attributed red flowers to his *M. denudata* (see Rehder & Wilson, I. c. 401). In this interpretation Schneider is followed by Valckenier Suringar (in Mededeel. Rijks Herb. Leiden 56, p. 25. 1928). In this case an erroneous statement in the original description has caused different interpretations by different authors and the interchange of the two names, *M. denudata* and *M. liliiflora* Desrouss.

In the cases mentioned above it has been possible to tie the name with more or less certainty to a definite part or citation of the original description and thus to conserve the original name. There are, however, cases, in which the original name includes two or more species variously interpreted by different authors; such names should according to article 51, 4 of the Rules be abandoned and will be dealt with under that article.

Other binomials which should be typified are: *Achras zapota* L., *Cleyera japonica* Thbg. (quoad flores).

#### RECOMMENDATION VI. d.

It does not seem logical to use nouns and adjectives in the plural form for coördinate subdivisions of a genus, though this had been done in *Primula* by Pax & Knuth (in Engler Pflanzenr. IV. 237, pp. 19, 45, 130. [1905]) where sect. 1 is called *Sinenses* and sect. 7 is called *Carolinella* and subsect. 1 of sect. *Auricula* is called *Eauricula* while subsect. 2 appears as *Brevibracteatae* and subsect. 3 again as a noun, *Arthritica*; thus both forms of names appear in the higher as well as the lower subdivision which makes the nomenclature rather confusing and not in agreement with the general custom. About ten years later in his monograph of *Saxifraga* (in Engler, Pflanzenr. IV. 117<sup>1</sup>) he uses nouns uniformly for the higher subdivisions and adjectives in plural form for the lower subdivisions. These two forms of names belong clearly to two different categories: the names in the form of nouns correspond to generic names and in many cases have been such before or they may become generic names if the group is elevated to generic rank; the names in adjectival form are usually derived from

names of species by putting these in plural form and can never become generic names or compete in any way with generic names. Therefore if a subgenus or section with a name in the form of a noun is changed to a series and in this new position the other coördinated groups have adjectival names, it should also receive a name in adjectival form, while the old name will become a synonym, or if the reverse of these changes takes place the adjectival name must be changed to a noun. The names of subgenera and of sections should be always nouns, also those of subsections except if the term is used in the place of series; the names of series and subspecies should be adjectives. If the name of a species upon which a name of a series in adjectival form is based, is a proper name in the genitive, the specific name should be changed to an adjective in the plural form, e. g. a series based on *Crataegus Douglasii* should take the name Ser. *Douglasianae*.

#### ARTICLE 28

Though the majority of botanists who follow the International Rules consider all these categories as of different rank, there is apparently no definite statement to that effect in the Rules, neither in articles 10 to 13 in which the arrangement of subordinate groups of the plant kingdom is carried to 21 degrees nor in article 49 which deals with changes of rank and where nothing is said of the change of one subdivision of a species to another subdivision, but only the change of a species to a subdivision of a species or vice versa is mentioned. One source of the opinion that the different subordinate subdivisions of a species are of different rank may be the English translation of the Rules which employs the term rank for the term "degré" as used in the original French text in article 12 and 28 and also for "rang hiérarchique" as used in article 29. Some authors apparently consider the different subordinate subdivisions below the species as one nomenclatorial class and take the oldest name, whether published as a variety or form, but cite the change from a lower to a higher subdivision or vice versa as a new combination; e. g. Pampanini in proposing as new the combination *Gentiana verna* var. *magellanica*,<sup>1</sup> takes the oldest combination *G. verna* f. *magellanica* Ronniger (1916) and not *G. verna* var. *Tenoreana* Vaccari (1917) or var. *vexans* Fiori (1926), though he should have accepted var. *Tenoreana* as the oldest name published as a variety, if he had considered forma and varietas as constituting different ranks. A similar opinion was voiced by botanists of Harvard University in their proposed amendments to the Paris Code<sup>2</sup>: "Subspecies, varieties and forms are not sharply definable or mutually exclusive categories, it is therefore better that, although their separate rank is maintained for classificatory purposes their names should be regarded as forming a single nomenclatorial class." There is also to be considered that the term varietas as used by one author may correspond to the subspecies of another author, or as used by a cer-

<sup>1</sup> In Bull. Soc. Bot. Ital. 1926, p. 42.

<sup>2</sup> Propos. Chang. Lois Nomencl. Bot. p. 18 (1904).

tain author it may correspond to the term *forma* of another, or speaking generally the same term may mean different things with different authors, and different terms as used by different authors may mean the same thing. Furthermore in many instances the names of subdivisions are preceded by letters or numerals only and it is by no means always certain for which grade they stand; this leaves too much play for varying individual interpretations and causes uncertainty.

If the subordinate subdivisions are considered as of different rank, the same group may have different names in accordance with the fact whether it is considered a *varietas* or a *forma*; e. g. *Spiraea tomentosa* [var.] *alba* Weston (1770) as a *forma* will have to be called *S. tomentosa* f. *albiflora* Blake, but if all subdivisions constitute one rank the name will be *alba* whether the combination is called *S. tomentosa* var. *alba* or *S. tomentosa* f. *alba* or *S. tomentosa alba*. (See also remarks under Art. 53.)

#### ARTICLE 29

The wording of the Art. 29 as it stands does not exclude the possibility, that the same name may be employed for two groups of different rank. If e. g. two species are united of which one contains a var. *pubescens* and the other a *forma pubescens*, there is nothing in the rules to prevent both names, since they are of different rank, from becoming valid names which would result in two different subdivisions bearing the same name. This, however, is against Art. 51. 2 which reads "Everyone should refuse to admit a name in the following cases: 2° When it duplicates the name of . . . a subdivision of the same species." It also is contrary to Recommendation XXIX. 3° which says: "retain the original epithet, unless this results . . . in two subdivisions of the same name in the same species." Therefore we must conclude that the correct interpretation of the Rules is to consider the subdivisions of a species as of a single nomenclatural class.

From the fact that a name can be used only once for a subdivision of a given species it follows that by the addition of one name to the binomial any subdivision is clearly designated or in other words that a trinomial is quite sufficient for the designation of any form of a polymorphous species. Only in exact citation and when it is desirable to give the exact taxonomic position the intercalated subdivisions should be quoted. E. g. *Lythrum Salicaria* var. *intermedium* subvar. *gracilis* f. *glabrum* Koehne gives the exact taxonomic position of the plant according to the author of the name, but as *Lythrum Salicaria* f. *glabrum* the plant is clearly and unmistakably designated. There is no reason in employing seven names as in *Saxifraga aizoon* subsp. *euaizoon* var. *typica* subvar. *brevifolia* f. *multicaulis* subf. *surculosa* Engler & Irmscher, if with only three names, *Saxifraga Aizoon* subf. *surculosa* or *S. Aizoon surculosa*, one can clearly designate the plant. The omission of intercalated subdivisions does, of course, not apply to terms like *typicus*, *normalis*, *genuinus*, etc., which are not names, but only titles and stand for the preceding superordinate group in a restricted sense.

RECOMMENDATION XV<sup>ter</sup>

Names like *Prunus glandulosa* var. *glabra* f. *Sieboldiana* subf. *rosea* Koehne are not to be recommended, since they all represent the type of the species and are different names for one and the same group; they only indicate a gradually narrower conception of this group.

## ARTICLE 31

Since by botanists, e. g. Hans Winkler, Camus, Daniel and others, who have studied and described graft-hybrids and chimeras names have been given to these plants, there does not seem to be any reason why these names should not be recognized and treated like those of sexual hybrids. Any botanist who disapproves of such names, is at liberty to use the formula instead.

## ARTICLE 32

It does not seem advisable to associate specific names of intergeneric hybrids with one of the two genera, since they do not agree in their characters with either one of the parent genera and therefore should not be placed there without a change in the characters of the genus in question. Furthermore it does not seem logical to allow specific names for hybrids between species, while prohibiting the giving of names to hybrids between genera, and this no doubt is the reason why a considerable number of botanists, as Camus, Guillaumin, Rolfe, Schneider, G. Beck, Hans Winkler, Daniel, etc., have employed these names, though they otherwise profess adherence to the International Rules. Also the rules of horticultural nomenclature adopted by the International Horticultural Congress at Brussels in 1910 allow by their articles XIII and XIV generic names for bigeneric and multigeneric hybrids, and harmony in this respect between these two sets of rules would be very desirable.

If between the same genera sexual and asexual hybrids occur, they may be classed under one and the same name, since the name is intended for intermediate forms between the two genera, though some botanists make a distinction and retain e. g. *Cratae-Mespilus* Camus (1899) for sexual and *Crataegomespilus* Jouin (1898) for asexual hybrids between *Crataegus* and *Mespilus*; the latter name being the earlier should be adopted for all the hybrids between the two genera. As it is, however, important and desirable to keep both kinds of hybrids distinct, there should be given a distinct specific name to the sexual and another name to the asexual hybrid, the former with the customary sign  $\times$ , the latter with the sign + before the name, e. g.  $\times$  *Pyronia Veitchii* Guillaumin for the sexual and + *P. Danieli* (Hans Winkler) Rehd. for the asexual hybrid.

## ARTICLE 34

The wording of art. 34 of the International Rules might possibly be interpreted as allowing the use of a varietal name under a formula, but I

do not think that this is the intention of the rule, since in the examples only a case of a binomial with a variety, namely  $\times$  *Mentha villosa*  $\beta$ . *Lamarckii* is cited, and a formula of which the variety belongs to the second component, namely *Salix caprea*  $\times$  *daphnoides* var. *pulchra*. To what utterly confusing nomenclature these formulas with varietal names attached may lead is shown by some combinations published by R. Keller who enumerates under the formula *Rosa gallica*  $\times$  *glauca* three forms A. *typica*, BI. *complicata* and BII. *myriodonta*,<sup>1</sup> representing hybrids of *R. gallica* with *R. glauca* f. *typica*, var. *complicata* and var. *myriodonta*.<sup>2</sup> According to my opinion Keller's names can not be considered correct, since in transferring these varietal names he applied them to different plants; he should have given new varietal names, as he did correctly in other instances, e. g. with *R. coriifolia* var. *complicata*  $\times$  *gallica* M. Schulze (l. c. 56) which he called *R. gallica*  $\times$  *coriifolia* f. *complicatoides* (l. c. 290). There was, however, no justification for changing Schulze's *R. coriifolia* f. *typica*  $\times$  *gallica* f. *aprifica* (l. c. 55) to *R. gallica*  $\times$  *coriifolia apricoides*, since Schulze's f. *aprifica* is a form of the hybrid and not of *R. gallica*. If both kinds of combinations should be considered admissible under the Rules, there should be at least some sign or abbreviation inserted to distinguish between varietal names belonging to the last component of the formula and those representing a subdivision of the hybrid. It seems, however, not logical to attach a varietal name to a formula, since a varietal name presupposes the existence of a specific name or a name corresponding to that of a species. If a hybrid between two species is not considered important enough to have a name of its own why should it be considered necessary to distinguish its variations by names?

#### ARTICLE 42

According to art. 40 "in order that the date may be readily verified it is necessary to quote the author who first published the name or combination of names in question." This emphasizes the importance of the publishing author and should lead in cases where besides the publishing author another author is given, to retain the more important author, if it is desirable or necessary to abbreviate a lengthy author citation. This is particularly important in names with the authority "Hort."; the citation "Hort." alone is almost meaningless, as it not infrequently happens that the same name has been used in different gardens for different plants and, moreover, this citation does not give the slightest hint when and where such a name may have started. A name like *Gesnera Donklarii* had no taxonomic or nomenclatural standing before Hooker described it, he is therefore responsible for it and should be cited as the responsible author. When botanical names are merely mentioned or quoted without citation of literature, it is usually desirable to abbreviate the author citation as

<sup>1</sup> In Ascherson & Graebner, *Syn. Mitteleur. Fl.* vi. pt. I. 288 (1902).

<sup>2</sup> M. Schulze in *Mitt. Geog. Ges. Jena*, v. Bot. Ver. Gesamtthür. p. 51, 52 (1887).

much as possible, and in such case a citation as *Mikania Karsteniana* Klotzsch apud Hieronymus should be shortened to *M. Karsteniana* Hieron. rather than to *M. Karsteniana* Klotzsch, because the latter citation would infer that the name could be found in a publication by Klotzsch and furthermore that the name was published before 1860, while in reality it was published 40 years later. The fact that Klotzsch wrote the name some time before 1860 on a herbarium specimen is comparatively unimportant, while the fact that Hieronymus published the name in 1901 with a descriptive note is of much greater importance.

A name of an older species is sometimes given erroneously to a plant which proves later to be a new species, e. g. *Pinus inops* Ait. was applied by Bongard to a Pine later described as *P. contorta* Dougl.; this name is always cited as *P. inops* Bong., though the full citation should read *Pinus inops* Aiton apud Bongard in Mém. Acad. Sci. St. Pétersb. ser. 6, II. 163 (1833), but in this case the publishing author is solely responsible for the interpretation of the name.

#### RECOMMENDATION XXV<sup>quat.</sup>

It is usually very important to know whether a name has been published as a valid name or a synonym, but often there is no reference to this fact, even when otherwise complete synonymy is given, and in trying to form an independent opinion as to the validity of the accepted name, one is forced to consult the original publication to find out the standing of the name in question. Also a more uniform usage of the prepositions "ex, apud, in" is desirable.

#### ARTICLE 45

A different attitude in regard to articles 45 and 47 dealing with the division of groups is one of the most important consequences of the acceptance and application of the type method which hardly entered into the International Rules as adopted at Vienna but is gaining more and more adherents among botanists and also recognition in the Rules as shown e. g. by the recommendation XVIII<sup>bis</sup> adopted in 1910 at Brussels which reads: "When publishing names of new groups to indicate carefully the subdivision which is regarded as the type of the group: the typical genus in a family, the typical species in a genus, the typical variety or specimen in a species."

Above all other considerations in deciding for which division the name of a genus is to be preserved, if it is divided into two or more genera, should stand the rule that it should contain at least one of the original species. This is not brought out in the rule as it stands, and by the examples cited one is led to assume that the conception and extent of the genus at the time of the division, should guide the decision for which part the generic name should be preserved. The original conception of the genus may have been considerably altered by that time, in some cases

even so much that the division for which the name was preserved has not contained any of the original species (as in *Alsine* L. in the sense of Wahlenberg and most later authors).

The rule that the name is reserved for the part which contains a great many more species is not sufficiently definite, for the opinion may differ how many species constitute a great many more. Should not according to this rule the name *Cistus* be given to the genus separated as *Helianthemum*, since many more species of *Cistus* in the original Linnean conception were transferred to *Helianthemum*, namely 20, while only 8 remained in *Cistus*? Why should not, as proposed above, the doctrine of residues which has been practiced to a great extent in the division of genera be followed with the safeguard that the group which retains the original name must always contain at least one of the species published with the first description? This species would then become the type or standard species of the genus.

In the case of *Erica* one could argue that *E. vulgaris* L. judging by its name should be considered the type of the genus, a conclusion strengthened by the fact that the generic description is based mainly on that species; this would result in renaming (as O. Kuntze did) all the species (about 500), except one, *E. vulgaris*, which would remain in the genus *Erica*. If we do not consider *E. vulgaris* L. the type species, the name will go to the larger part as well under the present rule, as under the rule as above proposed. It would, however, be advisable to place *Erica* on the list of *Nomina conservanda* with *E. Tetralix* L. as standard species to prevent any botanist from advocating to consider *E. vulgaris* the type species. Also such Linnean genera as *Mespilus*, *Crataegus*, *Bromus*, and many others should be placed on the list of *nomina conservanda* with citation of a standard species (see also Kew Bull. Misc. Inform. 1925, p. 49, 315).

#### ARTICLE 47

The proposed change allows of more general application than the original wording which referred chiefly to a special case. In many instances there is no form described earlier, but either a mixed description or a citation of additional specimens besides the one upon which the description is chiefly based. In many Linnean species it is often very difficult to decide which of the synonyms cited should be considered as representing the type or to which of the divisions of the original species the description applies. (see examples under art. 20 and 51, 4).

#### ARTICLE 48

If all the subdivisions of a genus and all the subdivisions of a species are considered as belonging to one rank as proposed under art. 28, the words "retaining there the same rank" become superfluous. As shown by the first example the subdivisions of a genus are apparently not considered as being of different rank, as may be also inferred from Recommendation

XXIX 2°; the same view should hold for subdivisions of a species which would be in accordance with Recommendation XXIX. 3°. (See also remarks under art. 28.)

#### ARTICLE 50

The wording of this rule as it stands has caused in many cases uncertainty in its application chiefly on account of the fact that no distinction is made between valid names and valid taxonomic groups, that is between nomenclatural and taxonomic validity. The wording of the rule: "No one is authorized to reject, change or modify a name . . . because of the existence of an earlier homonym which is universally regarded as non-valid," seems contradictory in itself, for a name is either valid or non-valid, depending on whether it is formed in accordance with the rules or not and it cannot be made so by universal consent. This becomes clearer by the revised article 56 which reads in part: "By valid name is implied a name and especially a combination of names formed in accordance with the rules of nomenclature." The strict adherence to this ruling will exclude a considerable number of homonyms which otherwise tend to make nomenclature unstable. As names that have become synonyms by change of generic or specific limitations may be revived at any time by another change in the taxonomic valuation of genera or species, I have termed non-valid names unconditional synonyms, and synonyms for taxonomic reasons conditional synonyms (see *Rhodora* XVII. 61, footnote). As an example, *Picea canadensis* (Mill.) Britton, Sterns & Poggenburg, may be cited. This name cannot stand on account of the *P. canadensis* (L.) Link which is the correct name of the Hemlock Spruce under the genus *Picea*. Even if *Tsuga* is now recognized as a distinct genus by almost all botanists and therefore *Picea canadensis* Link referred to *Tsuga canadensis* as a synonym, this should not make any difference, since *P. canadensis* Lk. is a name formed in accordance with the rules and therefore valid and at any time some botanist may unite *Picea* and *Tsuga* again and thereby cause *P. canadensis* Lk. to be revived.

#### ARTICLE 51

3. The original wording of part 3 could be so interpreted as to exclude names like *Viburnum macrocephalum* Fort., *Hydrangea macrophylla* DC., *Rosa xanthina* Lindl., *R. hemispheria* Herrm. and other Roses, which all undoubtedly are monstrosities having double flowers, or all of them changed into sterile flowers, but their description is not based on the monstrous character, and they are distinguished by other characters from related species. Cases like that of *Datisca hirta* L. are somewhat different.

Even names as *Uropedium* separated by Lindley by a monstrous character from *Cypripedium* might be retained "charact. mutatis" for *Phragmopedium* Rolfe as the oldest name, being the first generic name based on a member of this group. It seems hardly necessary to maintain Part 3 of

art. 51, since a name based on a monstrous character could in no case have a taxonomic standing and would be taxonomically non-valid and its nomenclatural validity would have no consequence.

This paragraph therefore can be cancelled and replaced by a rule that a name should not be considered valid "When it is the name of a species placed in a genus which has no affinity whatever to the genus to which the species really belongs." Such a rule will to a certain extent revive the so-called Kew rule and will prevent the acceptance of a name like *Rhodotypus scandens* based on *Corchorus scandens* for the well known *R. kerrioides* Sieb. & Zucc. It will prevent specific names given after careful study and comparison to species and placed in the right genus being superseded by names given without careful examination and without sufficient knowledge by careless workers like H. Léveillé. The original name in the wrong genus can and by most authors probably will be preserved even under the rule here advocated, if the plant is found to represent in the correct genus a new species e. g. *Berchemia alnifolia* Léveillé was transferred to *Corylopsis* by C. Schneider as *C. alnifolia* (Lévl.) Schneid; this is in accordance with the optional provision made in the last sentence of art. 56.

4. To secure the greatest possible stability in the nomenclature of binomials it seems necessary to know definitively which names should be considered a permanent source of confusion of error. The opinions of botanists in this respect are unfortunately not unanimous. Some consider names like *Betula alba* L., *Ulmus campestris*, L., *Rosa villosa* L., *Azalea lutea* as belonging to this category, while others retain these names and restrict them to one of the components of the original conception of the name. There seems to be only one way out of the differences in the application and use of these names and that is the compilation of a list of "nomina specifica rejicienda" which would form an appendix to the Rules.

#### ARTICLE 53

As already pointed out under art. 50 the introduction of taxonomic validity into the rules is not conducive to stability, therefore the expression valid group should be replaced by valid name or valid homonym, as defined in art. 56.

#### ARTICLE 58

It would be of great advantage and further the cause of the greatest possible stability in nomenclature if the Permanent Committee on Nomenclature could render binding decisions regarding interpretations of the Rules of Nomenclature, and add new names to the list of nomina conservanda and rejicienda. Undesirable changes of names and erroneous interpretation of the Rules could be prevented from gaining a foothold, if the discovery of a name which threatens the replacement of a well known name of an important genus or binomial could be brought before the Committee and a decision obtained within a reasonable time. If one has to wait

years before a congress convenes, changes in the names may be taken up by botanists though in many instances perhaps reluctantly and come into use, before decisive action could be taken. Moreover a congress is not the place to decide intricate questions of nomenclature, and even if carefully prepared by a special committee the voting on special cases of nomenclature would probably be more or less perfunctory, since the majority of voters would have no special knowledge of the case in question and not be able to obtain it on short notice.

If such a committee had existed, the coming into use of names like *Columella* Lour. for *Cayratia* Juss. which naturally will have in its wake the displacement of *Columellia* R. & P., the type of the family Columelliaceae, might have been prevented and also the changing of the name *Quercus rubra* from the Red Oak to the Spanish Oak and *Populus balsamifera* from the Balsam Poplar to the Cottonwood.

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#### NOTE ON THE NAMES OF HORTICULTURAL VARIATIONS

As an appendix to the propositions and the statements made above I should like to add a few words on the nomenclature of horticultural forms. I am interested in horticultural nomenclature and have recently proposed a few amendments to the Rules of horticultural nomenclature adopted at the International Horticultural Congress at Brussels in 1910. At the outset I wish to state that I can see no inherent difference between a form or a variation originated in the wild and one originated in the garden; a large number of so-called garden forms have originated in the wild and were transferred to the garden afterwards or they originated in seed-beds from seed collected from wild plants. Why should corresponding variations, one known from the wild and the other only from gardens, have a different nomenclatural status? There is certainly no difference in the character and taxonomic status between *Alnus glutinosa*  $\beta$  *lacinata* Willd. described from cultivated plants and *A. incana* f. *tomophylla* Fernald described from a wild plant, nor between *Ilex serrata* f. *xanthocarpa* Rehd. and *I. verticillata* f. *chrysocarpa* Robins., the first described from cultivated, the second from wild plants. Therefore, I can see no objections in giving both kinds the same nomenclatural treatment, for all plants, spontaneous as well as cultivated, are objects of botanical classification and it is not the fact whether a plant is growing in a garden or in the wild that makes the difference, but the purpose of the names. The purpose of botanical nomenclature is classificatory; in the case of varieties it aims to provide a name for each of the groups into which the whole mass of variations of a polymorphous species may be divided, the name being usually based on a type around which a number of more or less similar plants are grouped. The purpose of horticultural nomenclature is selective; it aims to give a name to a certain selected outstanding form without considering its re-

lation to others. The name is therefore that of an individual plant or of the equivalent of an individual plant, usually propagated vegetatively and thus representing practically a part of the original plant<sup>1</sup>; or in the case of garden forms raised from seed the name is applied only to plants exactly like the mother plant, deviations are discarded or if of horticultural merit, are made the starting point of a new race under a different name. It is therefore advisable that such individual plants or equivalents of individual plants should receive names different from botanical names which represent group names, and the general custom has been to give to them vernacular names, usually nouns like Avalanche, Snowdrift, Venus, John Waterer, C. S. Sargent, Kirishima, etc., which do not form a part of a botanical combination if appended to them and should be printed in a different type and enclosed in quotation marks. These names may be compared to the names of human individuals and will lapse when the plant disappears from cultivation, while a botanical name remains valid, even if the plant on which it was based ceases to exist; the name will be used again, if at any time a form appears which answers the description or the type specimen of the original form. If a name indistinguishable from a botanical name is given to a plant, it will have to be treated as a botanical name and follow the rules of botanical nomenclature; it can not be considered the name of an individual, but must be taken as the name of a group. Therefore a horticulturist who gives a Latin name which forms part of a botanical combination, does so to his disadvantage, for under the botanical name, according to the rules of botanical nomenclature, other similar forms can be classed which may be of inferior horticultural value compared with plant originally sent out under that name. *E. g.*, the name *Berberis Thunbergii* "Silver Beauty" or "Silver Beauty Barberry" stands for a distinct form and should not be applied to any other form however similar, while under the name *B. Thunbergii argenteo-marginata* other variegated forms may be grouped, differing perhaps in the character or color of the variegation and possibly of inferior horticultural value. Thus in purchasing a plant under *B. Thunbergii argenteo-marginata* one might receive a plant inferior to the original form, while as "Silver Beauty" one can expect a plant exactly like the original form and has a right to refuse any inferior substitute. Likewise a name like *Thuja occidentalis* f. *aurea* may be applied to several yellow-leaved forms differing perhaps in the shade of yellow and also in other slight characters as habit, but a name like "Meehan's Golden" stands for an individual form of *Thuja occidentalis* and its vegetative progeny.

Horticultural forms which originated from hybridization should be treated similarly. The name in the vernacular stands for the individual plant while the botanical name stands for the group, *e. g.*, *Cattleya* "Lord Rothschild" stands as the name of the original hybrid form so named,

<sup>1</sup> To such units in plant life the term clon (with long o, plural clons) has been applied. A clon may comprise thousands of plants, but they are in fact merely parts of the original individual plant multiplied by vegetative propagation (see also p. 50).

while *Cattleya Rothschildiana* is the group name for all the hybrids between *Cattleya Dowiana* and *C. Gaskelliana*, of which "Lord Rothschild" represents the type; likewise *Syringa Prestoniae* and the Lilac "Isabella" are both based on the same form, but the former name includes all the hybrids between *S. reflexa* and *S. villosa* while the latter is restricted to the original plant and its vegetative progeny, and may be designated either as Lilac Isabella or as *Syringa Prestonae* "Isabella."

Another important difference between botanical names and horticultural names is that the latter do not form combinations with generic names or binomials, though they may be appended to such names, and the author, who in most cases is also the originator or raiser of the form, always remains the same, whether the name is appended to a botanical generic name, to a binomial or to a vernacular name; e. g., the Lilac "Decaisne" Lemoine may be quoted as *Syringa "Decaisne"* Lemoine, as *S. vulgaris "Decaisne"* Lemoine, or Flieder "Decaisne" Lemoine without change of authority, also *Philadelphus Lemoinei* Lem. "Virginal" Lemoine if classed under *P. virginialis* Rehd. should be cited as *P. virginialis "Virginal"* Lem. but *Deutzia gracilis campanulata* Lemoine when transferred to *D. rosea* becomes *D. rosea* var. *campanulata* Rehd. or var. *campanulata* (Lem.) Rehd., since names indistinguishable from botanical names should follow the rules of botanical nomenclature. If they are undoubtedly names of individual plants these names in adjective form may be treated as nouns, written with capital letter and considered horticultural names as, e. g., the Lilac "Coerulea superba" Ellw. & Barry or *S. vulgaris "Coerulea superba"* Ellw. & Barry (in McKelvey, Lilac Monog. 278 [1928]). From the examples cited above it becomes evident that a vernacular name should not be duplicated within a genus except in the case of well defined groups as Plums and Cherries, while the same botanical name may be used several times in the same genus if classed under different species.

Regarding the question of author citations it seems advisable and practical to retain as done above for vernacular names which do not form combinations the original author citation even if appended to different botanical names or combinations. It is also clear and in accordance with the Rules of Botanical Nomenclature that for each new combination the author who is responsible for it should be quoted, but it is still doubtful whether the author citation should be changed when the combination of names remains the same and only the taxonomic valuation of the subdivision of the species is slightly changed as in *Gentiana verna* f. *magellanica* Ronniger (1916) which was called by Pampanini *G. verna* var. *magellanica* in 1926, or when the combination of names is changed by the addition or omission of intercalated groups, but the taxonomic valuation of the subdivision remains either the same or is also changed. If complete and exact synonymy will be given, the status of the combination in question can be made clear, but if the combination is quoted without synonymy it will often be difficult to know who should be quoted as the author since

the Rules as they stand at present are not definite. The simplest way out of this difficulty would be to quote the author who first placed the subdivision under the correct binomial, leaving the exact statement of the taxonomic valuation of the group by different authors to the synonymy. It is to be hoped that the Rules will be amended so as to be more explicit on these points.





*GMELINA PAPUANA* Bakh.  
Flowering branch ( $\times \frac{1}{2}$ ) and portion of under side of leaf ( $\times 2$ ).